Trading Down and the Business Cycle*

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Abstract

During the Great Recession many U.S. households have seen their real income fall. We combine several microeconomic datasets to show that a key way in which households have adjusted to lower incomes is by trading down, i.e. reducing the quality of the goods and services consumed. As we show, the production of lower-quality consumption goods uses less labor than that of higher-quality goods. Thus, as households trade down, the demand for labor falls. We show, empirically and theoretically, that the trading-down phenomenon accounts for a substantial fraction of the fall in U.S. employment. We then study two models with quality choice. We find that the presence of quality choice magnifies the response of these economies to real and monetary shocks, generating larger booms and deeper recessions.

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1 Introduction

One of the classic research areas in macroeconomics is the study of household consumption choices and their impact on the economy. There is a large empirical literature on this topic that goes back at least to the work of Burns and Mitchell (1946).[1]

In this paper, we contribute to this literature by documenting two facts. First, during the Great Recession consumers trade down in the quality of the goods and services they consume. For example, when dining away from home, households chose to eat more at lower-priced limited-service eating places, than at full-service restaurants.

The second fact we document is that the production of low-quality goods is generally less intensive in labor than the production of high-quality goods. Again, using the food away from home category as an example, in the U.S., employment per million dollar of sales in 2012 was 21.4 workers for full-service restaurants and 15.4 workers for limited-service restaurants.

Thus, ceteris paribus, the interaction of these two facts implies that when households trade down, there is a fall in labor demand that can increase the amplitude of the recession.

In order to document our two facts and quantify the magnitude of the "trading down" channel for employment during the Great Recession, we proceed as follows. We use three different data sources to construct a data set that includes firm-level measures of product quality and labor intensities. Specifically, for the quality measurement we use data from the website Yelp!, the confidential micro data set used to construct the Producer Price Index (PPI), and the Census of Retail Trade. Then, to compute a measure of labor intensity (such as employment per sales) for each firm in our sample we merge these sources with the firms' annual balance sheet information from Compustat. Furthermore, we complement these data sets with sector-specific restaurant data.

[1]Recent contributions to this literature include Aguiar, Hurst, and Karabarbounis (2013), Kaplan and Menzio (2015), Stroebel and Vavra (2015), and Nevo and Wong (2015).

Through simple quantitative exercises, we show that given lower labor intensity associated with lower-quality products and the shift in consumption to these products accounts for roughly a quarter to a third of the fall in employment during the Great Recession.

We view our finding that the trading-down phenomenon increased the severity of the recession as indicative of the importance of studying the general equilibrium effects of it. As such, we embed quality choice into two otherwise standard models: a flexible-price model and a Calvo-style sticky-price model.

We find that the presence of quality choice magnifies the response of these economies to real and monetary shocks, generating larger booms and deeper recessions. The reason is two fold.

Consider the case of an expansion in the economy. In standard business-cycle models, the response of workers to an increase in the real wage is muted by the presence of decreasing marginal utility of consumption. Workers who supply more labor enjoy less leisure. As they use the extra labor income to consume more, the marginal utility of consumption falls. However in the presence, The possibility of consuming higher quality goods reduces this fall, resulting in a stronger labor-supply response.

Second, in the model, as in the data, higher quality goods are increasing in their labor intensity. Then since during the boom consumers increase the quality of the goods they consume firms increase their demand for labor resulting in a stronger labor-demand response.

The quality-augmented model has two other interesting properties. The first, is that it generates comovement between employment in the consumption and investment sectors, a property that is generally absent in business cycle models (see Christiano and Fitzgerald (1998) for a discussion). The second, is that the model produces an endogenous, countercyclical labor wedge. As Shimer (2009) discusses, this type of wedge is necessary in order to be consistent with the empirical behavior of hours worked. Our paper is organized as follows. In Section 2, we describe our data and present our empirical results. The flexible and sticky price model are presented in Sections 3 and 4, respectively. Section 5 concludes.

2 Data

In this section we document the empirical findings that motivate our work. We begin by discussing in Sections 2.1-2.2 the main data sources we employ and our empirical findings. Specifically we present evidence that lower quality firms are characterized by lower labor intensity and that there has been a shift towards consumption of lower quality goods ("quality trade-down") over the Great Recession

We then extend our analysis method in Section 2.3 to the entire economy and complement our analysis in Section 2.4 using two distinct restaurant data sets. The first is data on expenditure on limited-service and full-service restaurants collected by Bureau of Economic Analysis as part of the National Income and Product Accounts (NIPA). The second, is data on traffic and revenue for restaurants in different quality segments collected by the NPD Group for the period 2007-2013.

Overall from this various sources we find that quality trade down accounts on average for roughly a quarter to a third of the fall in employment during the Great Recession. Specifically, our main period of analysis is 2007-12. The reason is as follows. Even though the NBER determined that the recession ended in June 2009, average and median household income continued to fall until 2012. In addition, employment recovered very slowly: in December 2012 employment was still 3 percent below its December 2007 level. However, for robustness, we also report results for the period 2007-09.

2.1 Yelp! and Census of Retail Trade data

In this section, we use data from Yelp! and from the Census of Retail Trade. The combined data set covers six North American Industry Classification System sectors: accommodation, apparel, grocery stores, restaurants, home furnishing, and general merchandise. These sectors represent 17 percent of private non-farm employment.

Yelp!

For the first five sectors (accommodation, apparel, grocery stores, restaurants, and home furnishing) we obtain a measure of price by scraping data from Yelp!. Yelp! is a website founded in 2004 to allow consumers to share reviews about different goods and services.[2] Specifically, for each store and location pair, Yelp! asks its users to classify the price of the service into one of four categories: $ (low), $$ (middle), $$$ (high), and $$$$ (very high). Since there are few observation in the very-high category, we merge the last two categories into a single high-price category ending with three price categories.[3]

These three price categories serve as our measure of quality tiers. That is, with the Yelp! data, as in most of our analysis, we use prices as a proxy for quality. Our assumption is that, if consumers are willing to pay more for an item, they perceive it to be of higher quality.

For brevity we offer below a short discussion of the construction of the Yelp! data. In Appendix A, we discuss this in detail. We first associate each firm (for example, Cost Plus, Inc.) with its brand names and retail chains (for example, Cost Plus owns the retail chain World Market). We find the Yelp! profile for each retail chain and brand in the 18 largest U.S. cities and collect the first match (for example, the first match for World Market in Chicago is the store on 1623 N. Shefield Av.). We then compute the average price category across the first match for each of the 18 cities (to compute this average, we assign 1 to category low, 2 to middle and 3 to high).[4]

[2]This fact limits our possibility to use Yelp! for prior recession.

[3] Yelp! users also rate the quality of the goods and services they consume. But these ratings are not useful for our purpose because they are not an absolute measure of quality. Instead, they measure the quality of an item, relative to the price paid for that item. A fast-food restaurant that receives five stars might be worse than a high-priced restaurant that receives three stars.

[4]The dispersion in price categories across cities is relatively small; it is rare for firms to be included in different price categories in different cities.

We then merge each firm with its annual balance sheet information from Compustat on the number of employees, sales, operating expenses, and cost of goods sold. The primary labor intensity measure we use is the ratio of employees to sales. The choice of this measures was dictated by data availability considerations. Less than 1/4 of the firms included in Compustat data report the share of labor in total cost, which is a natural measure of labor intensity. In the sample of firms that report the labor share in cost, the correlation between labor share and employees/sales is 0.94.

As a robustness check, we also use the employees/(sales - cost of goods sold). With this measure we control for the possibility that higher quality products are sold at higher price because of an higher cost of goods.[5] The correlation between this measure and our primary measure of the ratio of employees to sales is significantly positive at 0.72 percent.[6]

U.S. Census of Retail Trade

For General merchandise, the U.S. Census of Retail Trade splits firms into three price tiers that correspond to three different levels of quality: non-discount stores (high quality), discount department stores (middle quality), other general merchandise stores, including family dollar stores (low quality). For each of these three tiers the Census provides information about employment and sales. We use this to construct labor intensity measures.

Findings

We first note that the resulting distribution of firms by price category is as follows. The low-, middle- and high-price categories account for 25, 57, and 18 percent of the number firms, respectively. The distribution of sales across price categories is similar. The low-, middle- and high-price categories account for 35, 53, and 12 percent of sales,

[5] Value added is equal to sales minus cost of goods minus energy and services purchased. We cannot compute value added because we do not have on energy and services purchased.

[6] The correlation between labor share and employees/(sales - cost of goods sold) is 0.97.

respectively.

Table 1 documents our first fact: between 2007 and 2012 firms that produce middle- and high-quality items lost market share relative to firms that produce low-quality items. This pattern emerges for the six sectors we consider with one exception: the market share of high-quality grocery stores increased. This exception is driven by the fact that WholeFoods gained market share despite the recession.[7]

Table 1: Market Share Changes by Quality

Sector	**Low**	**Middle**	**High**
Accommodation	0.5%	0.4%	-0.9%
Home furnishing stores	0.1%	-0.5%	0.4%
Grocery stores	3.9%	-6.4%	2.6%
Restaurants	8.6%	-7.9%	-0.6%
Apparel stores	4.3%	-0.6%	-3.7%
General merchandise stores	8.5%	-4.8%	-3.8%
Total	**4.8%**	**-4.1%**	**-0.7%**

Table 2 documents our second fact: both our measures of labor intensity are in-

[7] Other examples of the firms and their Yelp! quality categorization are as follows. In the Accommodation sector: Choice (low), IHG, (middle), Starwood (high). In the Home Furnishing sector: Lumber Liquidators (low), Lowe's, (middle), Williams-Sonoma (high). In the Grocery Store sector: Sam's Club (low), Safeway, (middle), WholeFoods (high). In the Restaurant sector: McDonald's (low), Cheesecake Factory, (middle), Del Frisco (high). In the Apparel Stores sector: Ross (low), Gap, (middle), Abercrombie Fitch (high). In the General Merchandise Store sector: Dollar stores (low), Discount, (middle), Non-discount (high).

creasing in quality.[8] For example, the number of employees per million dollar of sales is 22.4, 19.5, and 13.4, for high-, middle- and low-quality restaurants, respectively. Hence, ceteris paribus, a shift of a million dollar of sales from a middle-quality restaurant to a low-quality one destroys roughly six jobs.

Table 2: Employees per Million Dollar Sales

Sector	**Low**	**Middle**	**High**
Accommodation	6.3	8.6	21.6
Home furnishing stores	3.5	4.9	5.9
Grocery stores	1.9	4.2	6.1
Restaurants	13.4	19.5	22.4
Apparel stores	6.5	9.2	15.1
General merchandise stores	3.7	6.9	7.2
Total	**5.5**	**8.5**	**11.1**

* Labor intensity in 2012.

Similar results are obtained when considering our second measure of labor intensity, employment/(sales-cost of goods sold), as Table 3 reports below.

[8] Similar results are obtained when using the labor intensity measures in 2007; See footnote 10.

Table 3: Employees per Million Dollar of (Sales *less* COGS)

Sector	**Low**	**Middle**	**High**
Accomodation	6.28	8.62	21.60
Home furnishing stores	8.25	14.68	15.57
Grocery stores	14.62	16.61	16.33
Restaurants	53.53	85.08	125.80
Apparel stores	21.20	21.62	26.68
General merchandise stores	16.23	24.26	19.49
Total	**21.50**	**31.26**	**39.01**

* Labor intensity in 2012.

To quantify the effect of "trading down" and the effects of changes in market shares on employment we perform a simple accounting experiment. First, for each sector j we define the market share of each of the three quality tiers (low, middle or high - denoted by i) at a given year as

$$\text{market share}_{year,i,j} = \frac{\text{sales}_{year,i,j}}{\text{total sales}_{year,j}}. \tag{1}$$

Then, for each sector j, we write employment in 2012 using the following identity:

$$N_{2012,j} = \text{total sales}_{2012,j} \sum_i \text{market share}_{2012,i,j} \left(\frac{N_{i,j}}{\text{sales}_{i,j}} \right)_{2012}. \tag{2}$$

Second, we compute, N^*_{2012}, the employment that would have resulted in 2012 if the market shares of different firms were the same as in 2007:

$$N^*_{2012,j} = \text{total sales}_{2012,j} \sum_i \text{market share}_{2007,i,j} \left(\frac{N_{i,j}}{\text{sales}_{i,j}} \right)_{2012}. \tag{3}$$

Third, we compute the change in employment accounted for by changes in market share as:

$$N_{2012,j} - N^*_{2012,j} = \text{total sales}_{2012,j} \sum_i (\text{market share}_{2012,i,j} - \text{market share}_{2007,i,j}) \left(\frac{N_{i,j}}{\text{sales}_{i,j}} \right)_{2012}. \tag{4}$$

Table 4 reports the results of this decomposition.[9] Between 2007 and 2012 high-quality producers lost 1 percent in market share, middle-quality producers lost 4 percent, and low-quality producers gained 5 percent. In the data, overall employment in the sectors included in our data declined by 7.9 percent between 2007 and 2012. The change in employment accounted for by trading down is −2.6 percent; i.e. trading down accounts for 33 percent of the fall in employment. When we consider the period 2007-2009, we find that employment in the sectors in our data declined by 4.5 percent. The change in employment accounted for by trading down is −1.4 percent, which represents 31 percent of the fall in employment.[10]

[9]The total change in employment accounted for by trading down is a sum of two components: the direct effect of quality shifts on employment within the same sector and the indirect effect on employment in other sectors that provide intermediate inputs to the sector that experience trading down. For brevity we note that the indirect effects are quite small, so our results are similar whether we include them or not. We refer the reader to Appendix C for a discussion of the way we compute this indirect effects.

[10]Using employment/sales and total sales measured in 2007 instead of in 2012 in equation (4) we obtain very similar results: 32 percent of the change in employment is accounted for by trading down.

Table 4: Employment Effect of Quality Trade Down

Quality (q)	△ Market share	Labor intensity	Implied △ Emp	Actual △ Emp
Low	5ppt	5.6	978,000	2,105,000
Middle	−4ppt	9.1	-1,351,000	-3,635,000
High	−1ppt	11.1	-210,000	-214,000
Total Change			-582, 000	−1, 744, 000
Total Percentage Change			-2.6%	-7.9%

In similar fashion, Table 5 reports our calculation using our second measure of labor intensity, employment/(sales-cost of goods sold). For the period 2007-12, the change in employment accounted for by trading down represents 42 percent of the fall in employment. For the period 2007-09, this fraction represents 32 percent of the fall in employment.

Table 5: Employment Effect of Quality Trade Down

Quality (q)	$\triangle$ Market share	Labor intensity	Implied $\triangle$ Emp	Actual $\triangle$ Emp
Low	6ppt	21.5	1,266,854	2,105,000
Middle	-5ppt	31.3	-1,539,960	-3,635,000
High	-1ppt	39.0	-453,121	-214,000
Total Change			-726, 227	$-1,744,000$
Total Percentage Change			-3.3%	-7.9%

Our final point is presented in Table 6. The table shows that in general, during the Great Recession, low-quality producers expanded employment while middle- and high-quality producers contracted employment. This evidence is consistent with the the quality trade down hypothesis: even during the Great Recession, in five out of the six sectors employment actually grew at the low quality tier. Moreover, in all of the sectors, the middle quality tier so a fall in employmens. In the high quality tier four out of the six sectors saw also a fall in employment. In the two sectors where employment expanded in high-quality tiers (grocery stores, as a result of the expansion of Wholefoods and restaurants) this increase is orders of magnitude smaller than then increase in employment exhibited in the low quality tiers within the same sectors.

Table 6: Employment changes by Sector and Quality Segment

Sector	Low	Middle	High	Total
Accomodation	-23	-7	-118	-149
Home furnishing stores	7	-947	-74	-1,014
Grocery stores	99	-291	40	-152
Restaurants	1,613	-1,882	101	-167
Apparel stores	1	-231	-92	-322
General merchandise stores	408	-276	-72	61
Total	2,105	-3,635	-214	-1,744

2.2 The PPI data

In order to extend the analysis to other sectors of the economy we use the confidential microdata used by the BLS to construct the PPI.[11] The PPI data set measures producers' prices for manufacturing, services, and all the other sectors of the economy.

As with the Yelp! data, we merge the PPI data with Compustat to obtain both price and labor intensity information for each firm. This combined data set that has $62,000$ monthly observations for the period 2007-12. Overall the sectors covered by the merged PPI and Compustat data account for 22 percent of private non-farm employment. We

[11] Nakamura and Steinsson (2008), Gilchrist et al (2014), Gorodnichenko and Weber (2014), and Weber (2015) use versions of this data set as well.

refer the reader to Appendix B for the specific methods we follow in creating this data set.

We focus on the 2-digit NAICS manufacturing sectors 31, 32, and 33, and the retail trade sector 44, because we are able to merge a sufficient number of firms within the PPI sample with the Compustat database. Specifically, we are able to merge over 10 firms per sector and span a range of quality tiers.

In order to construct an indicator of quality of each firm, we need the *l*evel of the unit price per item rather than the inflation rate per item. The PPI provides information on the unit of measure for each item, which we use to ensure that all items in our sample have the same unit of measure. Unfortunately, sufficient information on the unit of measure is only available from 2007 onwards, with a large number of missing observations prior to 2007. This restricts our ability to extend the analysis on the PPI back to prior recessions, and so therefore we focus our analysis on the recent recession.

In order to construct a quality measure per each firm we proceed as follows. For each product k that establishment e sells in year t we calculate its price, p_{ket}, relative to the median price in the industry for product k in year t, $\bar{p}_{kt}$:[12]

$$R_{kwt} = p_{kwt}/\bar{p}_{kt}.$$

For single-product establishments, we use this relative price as the measure of the quality of the product produced by establishment e. For multi-product establishments, we compute the establishment's relative price' as a weighted average of the relative price of different products, weighted by shipment revenue in the base year (w_{kf}):[13]

[12]Our analysis is based on products defined at a six-digit level. As such, $\bar{p}$ is a shipment-value weighted average within the six-digit level. For reporting purposes, we aggregate the results to the two-digit level. The aggregation is done based on shipment revenue.

[13]The approach of constructing of firm-level price indices is similar to the approach taken by Gorodnichenko and Weber (2014), and Gilchrist et al (2014). We refer the reader to Section II in Gorodnichenko and Weber (2014) regarding how the BLS samples products and firms.

$$R_{ft} = \sum_{k \in \Omega} w_{kf} R_{kft}.$$

where Ω denotes the set of all products in the PPI data set that we examined.

To make our results comparable with those obtained with Yelp! data, we proceed as follows. Once we rank establishments by their relative price, we assign the top 15 percent to the high-quality category, the middle 55 percent to the middle-quality category, and the bottom 35 percent to the low-quality category. Recall that this is the distribution of firms by the quality tier is the one we found to characterize the firms used in the Yelp! analysis

We aggregate the establishment quality tier assignment to a firm level by taking a shipment-value weighted average of the quality tier and round to the closest quality tier. Finally, we merge the firm-level quality tier assignment from the PPI with the Compustat sample of firms.[14] This allows us to compute labor intensity by quality tier using the Compustat financial data.[15]

Tables 7-9 shows that our two key facts hold for PPI data as well. First, low-quality firms gained market share between 2007 and 2012 at the cost of middle and high-quality firms. Second, quality is correlated with labor intensity. High quality producers have higher labor intensity than middle quality producers and middle quality producers have higher labor intensity than low quality producers.

[14]The aggregation of establishments up to a firm level uses the matching done by Gorodnichenko and Weber (2014), who shared their code with us. In their work, they manually matched the names of establishments to the name of the firm. They also search for names of subsidiaries and checked for any name changes of firms within the Compustat data set. See Gorodnichenko and Weber (2014) for more detail. A similar exercise of matching establishments to firms was also performed in Gilchrist et al (2014).

[15]We use the entire sample of establishments within the PPI to rank the establishments, not just those that we are able to match with Compustat."

Table 7: Market Share Changes by Quality

NAICS Sector	Low	Middle	High
31 Manufacturing: Food, textiles, etc.	11.3%	-11.3%	n.a.
32 Manufacturing: Wood, chemical, etc.	0.9%	1.9%	-2.8%
33 Manufacturing: Computers, equip., etc.	6.8%	-6.5%	-0.3%
44 Retail trade	3.2%	-2.8%	-0.4%
Total	4.5%	-3.6%	-0.9%

Table 8: Employment per Million Dollar Sales

NAICS Sector	Low	Middle	High
31 Manufacturing: Food, textiles, etc.	0.4	3.41	n.a.
32 Manufacturing: Wood, chemical, etc.	2.69	2.85	4.59
33 Manufacturing: Computers, equip., etc.	1.40	2.41	3.32
44 Retail trade	2.92	4.99	12.75
Total	2.16	3.52	6.61

Table 9: Employment per Million Dollar of (Sales *l*ess COGS)

NAICS Sector	Low	Middle	High
31 Manufacturing: Food, textiles, etc.	5.81	6.87	n.a.
32 Manufacturing: Wood, chemical, etc.	5.66	8.35	13.99
33 Manufacturing: Computers, equip., etc.	4.27	10.61	16.30
44 Retail trade	12.83	14.60	21.02
Total	7.70	11.07	15.61

Armed with these result we repeat our accounting exercise as in equations (3) and (4). We report the results in Table 10. We find that trading down accounts for 22 percent of the jobs lost between 2007 and 2012 and 16 percent of the the jobs lost between 2007 and 2009.[16]

[16]When we use employment/(sales - cost of goods sold) as our measure of labor intensity, we find that 23 percent of the jobs lost between 2007 and 2012 and 8 percent of the the jobs lost between 2007 and 2009.

Table 10: Employment Effect of Quality Trade Down

Quality (q)	$\triangle$ Market share	Labor intensity	Implied $\triangle$ Emp
Low	5ppt	2.2	$679,998$
Middle	-4ppt	3.5	-$1,216,488$
High	-1ppt	6.6	-$329,477$
Total Change			-$865,968$
Total Percentage Change			-3.6%
Actual Total Change			-$2,909,607$
Actual Percentage Change			-16.2%

In sum, our results using the PPI data are broadly similar to those obtained with the Yelp! data. Higher quality goods, which are generally more labor intensive, lost market share during the recent recession. This loss of market share accounts for about a quarter of the overall decline in employment in these sectors.

2.3 Extending the analysis to the rest of the economy

So far, we focused on sectors for which we have price measures. In order to extend the analysis beyond these sectors we proceed by using labor intensity, instead of price, as a measure of quality. The rationale for this is that labor intensity is positively correlated with quality. We use the same two equations as before (equations (3) and (4)) but the subscript i refers to an individual firm instead of to a quality tier.

Specifically, within each 3-digit NAICS sector, we then compute the market share for each firm within the sector in 2007. We compute a counter-factual employment for each firm by multiplying the firm's 2012 employment numbers with their with their 2007 market share. Summing up over all firms within the sector then gives the counter-factual employment that would have occurred if there were no changes in market shares within the sector. We then sum over all sectors in the economy to get an aggregate counter-factual employment number, which we can compare to actual employment.

Doing our accounting exercise using employment/sales as our measure of labor intensity, we find that trading down accounts for 28 percent of the jobs lost between 2007 and 2012 and 23 percent of the the jobs lost between 2007 and 2009.[17]

2.4 Other data sets

We proceed by analyzing two other data sets: NIPA data for restaurant expenditures and sectoral marketing data for restaurants. These data sets provides further evidence regarding the presence of quality trade down and its implication for employment.

2.4.1 Restaurant data: I

The BEA disaggregates NIPA quarterly measures of real expenditures on "Food away from home" into two categories: expenditures on limited-service (lower quality) restaurants and on full-service (higher quality) restaurants.

While overall expenditures on food away from home fell by 7.4 percent between the beginning and the end of the recession, real expenditure on limited-service restaurants fell by only 4.7 percent, while real expenditure on full-service restaurants fell by 10.2 percent. Overall, limited- service restaurants gained 1.5 percentage points of market

[17]Our results are robust to excluding sectors in which there is not much scope for the consumer to trade down: Utilities, Warehousing and Storage, Waste Management and Remediation Services, and Water Transportation.

share over 2007-2009, and 1.3 percentage points over 2007-2012. Thus, this shift in expenditure pattern provide further evidence of trading down.

The Current Establishment Statistics conducted by BLS reports employment data for limited-service and full-service restaurants. Using these data, we find that the employment per sales in 2012 is 21.4 for full-service restaurants and 15.4 for limited-service restaurants.

Thus, the change in employment implied by this change in market share is -0.5 percent for 2007-2009, and -0.4 percent over 2007-12. This change over 2007-2009 represents 17 percent of the total change (-2.7 percent) in employment in the food away from home sector for 2007-09. Over 2007-2012, the change in market share represents 36 percent of the total change (-1.2 percent) in employment in the food away from home sector.

2.4.2 Restaurant data: II

Our second source of restaurant data is from the consulting firm NPD. The data is split by four categories of service: quick-service restaurants, midscale restaurants, casual dining, and fine dining/upscale. These categories are designed to represent different levels of quality.

We first report restaurant traffic (number of meals served) by four categories of service: quick-service restaurants, midscale restaurants, casual dining, and fine dining/upscale. These categories are designed to represent different levels of quality.

Second, we find clear evidence of trading down in the NPD restaurant data. Overall between December 2007 and December 2012 there has been virtually no change in this measure at the quick-service restaurants. This stands in contrast to to a fall of 14% at the miscall category. Similarly, the casual dining and find dining segments have registered a fall of 9% and 6% at restaurant traffic. Table 11 reports the yearly change in restaurant traffic across the four categories highlighting the evolution of the trading down observed in the restaurant data. [18]

Table 11: Change in Restaurant Traffic by Year and Quality Segment

	2008	2009	2010	2011	2012	% of 2012 traffic
Quick service restaurants	0.6	-2.3	0.2	0.8	1.1	78.5
Midscale	-1.8	-4 .3	-3.2	-3.4	-2.3	9.7
Casual dining	-0.3	-3.2	-1.8	-2.0	-1.7	10.2
Fine dining/upscale hotel	-0.9	-12.7	-0.2	3.8	4.5	1.4

Turning to the amount of consumer spending in restaurants, revenue rose by 11%6 for quick-service restaurants, fell by 3% for midscale rose by 2% and 6% for the casual dinging and fine dining respectively.[19]

Table 12 reports the yearly change in restaurant consumer spending restaurants.

[18]There is also some evidence in the NDP data that consumers traded down in terms of the meal they choose to eat at restaurants, eating out at breakfast and lunch instead of at dinner.

[19]In interpreting this evidence it is important to keep in mind that the fine-dining segment accounts for only 6 percent of total restaurant revenue. So, the impact of trading up to fine dining is small relative to the impact of trading down to quick-service restaurants.

Table 12: Change in Restaurant Revenues by Year and Quality Segment

	2008	2009	2010	2011	2012	% of 2012 traffic
Quick service restaurants	2.6	0	1.7	2.2	3.6	60.2
Midscale	0.8	-2.0	-0.5	-0.8	-0.1	13.7
Casual dining	1.7	-1.1	0.6	-0.1	0.5	20.2
Fine dining/upscale hotel	-0.4	-9.7	3.6	6.5	6.8	5.7

Unfortunately, we cannot perform the accounting calculations since the NPD does not breakdown employment across the different segments.

2.5 Summary

Table 13 provides a summary of our results. This table suggests that employment effects of trading down are quantitatively large. During the 2007-12 period, trading down accounts for 22 to 36 percent of the jobs, depending on the measure of quality used and the data set.

Table 13: Summary of Employment Effect of Quality Trade Down

Data set	Quality measure	2007-12	2007-09
Yelp! and Census of Retail Trade	Price	33	31
PPI	Price	22	16
Compustat (all sectors)	Labor intensity	28	23
NIPA	Store category (Limited versus full service)	36	17

3 A flexible-price model

Our empirical results show that the trading-down phenomenon increased the severity of the recession. We view this as indicative of the importance of studying the general equilibrium effects of it. As such, we begin by studying a flexible-price model where households choose the quality of the goods they consume.

We first consider a static version of the model. This simplified version allows to to highlight the key mechanisms in the model and to derive some analytical results. We and then turn to a stochastic dynamic version of the model and asses its predictions vis-a-vis the U.S. data.

3.1 A static model

We assume that the model has a representative household so, in equilibrium, all the households choose the same level of quality and only this quality is produced. As such, there is a single consumption good in the economy that can be produced at different levels of quality, q. Consistent with our parametrization (to be discussed below) below and with our empirical approach, we assume that the price of the consumption good is increasing in quality. Thus households face the following trade off: consuming higher quality goods yields higher utility but higher-quality goods are more expensive.

Households

The household derives utility from both the quantity, C, and the quality , q, of consumption and disutility from work, N:

$$U = U(C, q, N). \tag{5}$$

The household's budget constraint is:

$$P(q)C = wN + RK, \tag{6}$$

where $P(q)$ is the price of one unit of consumption of quality q, w denotes the wage rate, K the capital stock, and R the rental rate of capital. The stock of capital is constant.

As usually we assume that

$$U_1(C, q, N) > 0 \tag{7}$$

$$U_3(C, q, N) < 0 \tag{8}$$

With respect to quality, we naturally assume that

$$U_2(C, q, N) > 0 \tag{9}$$

We are interested in a model where quality is a normal good.[20] While this condition seems natural it does impose restrictions on the functional form of the utility function. To see this we note that the first-order condition for the household problem can be written as:

$$\frac{U_2(C, q, N)}{U_1(C, q, N)} = \frac{P'(q)C}{P(q)}, \tag{10}$$

[20]See Appendix D.

$$\frac{U_3(C,q,N)}{U_1(C,q,N)} = -\frac{w}{P(q)}. \tag{11}$$

These two equations imply that if U is homogeneous in C, quality is independent of income. Thus, in order for quality to be a superior good, a necessary condition is that U is non-homothetic in C.

Given this requirement in mind, we assume that U takes the form:

$$U = \frac{q^{1-\theta}}{1-\theta}\frac{C^{1-\sigma}-1}{1-\sigma} - \phi\frac{N^{1+\nu}}{1+\nu}. \tag{12}$$

The advantage of this functional form is that it nests the usual separable utility in consumption and hours worked as a special case. This greatly simplifies the analysis of the role quality choice in the model.[21]

For future reference we note that given the utility functional form, the first order conditions in equations 10-11 become:

$$\frac{1-c^{\sigma-1}}{1-\sigma} = \frac{1}{1-\theta}q\frac{p'(q)}{p(q)}, \tag{13}$$

$$\phi N^{\nu} = \frac{q^{1-\theta}}{1-\theta}C^{-\sigma}\frac{w}{P(q)}. \tag{14}$$

Production

We assume that producers are perfectly competitive. To produce C units of a consumption good with quality q, they combine labor and capital according to the following CES production function:

$$C = A\left[\alpha\left(\frac{N}{q}\right)^{\rho} + (1-\alpha)\left(K\right)^{\rho}\right]^{\frac{1}{\rho}}, \tag{15}$$

where A denotes a Hicksian netutral technology level.

[21]In order for utility to be increasing in quality ($U_q > 0$) it has to be $\left(C^{1-\sigma}-1\right)/(1-\sigma) > 0$. In order for this condition to hold, it is sufficient that $C > 1$.

We assume that income is high enough that this condition always holds.In our stochastic simulation we verify that this condition holds at each point in time.

The producer's problem is:

$$\max P(q)C - wN - rK. \tag{16}$$

We assume that $\rho < 0$, so there is less substitution between capital and labor than in a Cobb-Douglas production function. This assumption is necessary so that, as in the data, higher quality goods are more labor intensive.[22]

The price schedule, $P(q)$, implied by the firm's first-order condition is:

$$P(q) = \frac{1}{A}\left[\alpha^{\frac{1}{1-\rho}}(qw)^{\frac{\rho}{\rho-1}} + (1-\alpha)^{\frac{1}{1-\rho}} r_t^{\frac{\rho}{\rho-1}}\right]^{\frac{\rho-1}{\rho}}.$$

We note that the price schedule increases with the good's quality, i.e. $P'(q) > 0$.

Comparative Statics

We now consider the effect of an increase in A. Consider first a version of the model where quality is fixed, so that $q = 1$ and the price of the consumer good is normalized to one. For simplicity and consistent with our calibration (see below) we assume that $\sigma = 1$ (i.e. log preferences in consumption). The first-order conditions for the household problem imply:

$$\phi N^{\nu} = \frac{w}{C}. \tag{17}$$

[22] Using the first-order conditions for the firms' problem the measure of labor intensity we use in our empirical work as:

$$\frac{N}{P(q)C} = \frac{\left[\frac{w}{r}\frac{1-\alpha}{\alpha}\right]^{1/(\rho-1)}}{\frac{r}{1-\alpha}\left\{\alpha\left[\frac{w}{r}\frac{1-\alpha}{\alpha}\right]^{\rho/(\rho-1)} + (1-\alpha)q^{1/(1-\rho)}\right\}}.$$

This expression implies that labor intensity rises with quality only when $\rho < 0$. Furthermore, we note that it is interesting to consider two additional measures of labor intensity, the labor-capital ratio and the labor share, even though we cannot construct empirical counterparts to these measures. Using the first-order conditions for the firms' problem we can write these measures as:

$$\frac{N}{K} = \left[\frac{1-\alpha}{\alpha}\frac{w}{r}\right]^{1/(\rho-1)} q^{\rho/(\rho-1)},$$

$$\frac{wN}{P(q)C} = \frac{1}{1 + (w/r)^{\frac{\rho}{1-\rho}}\left[(1-\alpha)/\alpha\right]^{\frac{1}{1-\rho}} q^{\frac{\rho}{1-\rho}}}.$$

The condition $\rho < 0$ is also necessary so that these measures of labor intensity increase with q.

It is easy to see that since both w and C are proportional to A, changes in A have no effect on the labor supply. The income and substitution effects of changes in wages are exactly offsetting, so N is constant.

In contrast, in the model with quality choice an increase (decrease) in A does lead to an increase (decrease) in N. I.e. there is (infinite) increase in the fluctuations in hours workers relative to the model without quality choice.[23]

The intuition behind this result is as follows. When A rises, the consumer has more income and so he consumes more. Equation (13), together with the fact that $P'(q) > 0$, implies that it is optimal for households to consume both more quantity and higher quality. The rise in quality shifts up the marginal utility of consumption schedule, which is given by $q^{1-\theta}C_t^{-\sigma}/(1-\theta)$, leading to a rise in N (see equation (14)). Moreover, the increase in the demand for quality, increases the demand for labor given the fact that the production function has labor intenstity increasing with quality.

In summary, when A rises (i) households are willing to work more because they can buy higher quality goods, and (ii) firms demand more labor in order to produce higher quality goods.

3.2 A dynamic model

We now consider a dynamic, stochastic version of the model. The household's problem is:

$$\max U = E_0 \sum_{t=0}^{\infty} \beta^t \left[\frac{q_t^{1-\theta}}{1-\theta} \frac{C_t^{1-\sigma} - 1}{1-\sigma} - \phi \frac{N_t^{1+\nu}}{1+\nu} \right], \tag{18}$$

s.t.

$$P(q_t)C_t + P_t^I I_t = w_t N_t + r_t K_t, \tag{19}$$

$$K_{t+1} = I_t + (1-\delta)K_t, \tag{20}$$

[23] The proof involves tedious algebra and it is available upon request from the authors.

where I_t and P_t^I denote the level and the price of investment, respectively. E_0 is the conditional expectation operator.

Note that the model is a two-sector model. We study this model and not a one-sector model for two reasons. First, our empirical evidence is about the behavior of consumers as they "trade down" the quality of their goods and services. None of our results covers firms' investment decisions. As such it seems only natural to have a "quality change" solely in the consumption sector.[24]

The first-order conditions for the household are two equations associated with the static model (equations (13) and (14)), together with the following additional condition:

$$\lambda_t = E_t \beta \lambda_{t+1} \left(1 + r_{t+1}\right). \tag{21}$$

Here, λ_t is the Lagrange multiplier associated with the household's budget constraint (Equation (19)).

As in equation (15), consumption is produced by a continuum of measure one of competitive firms

$$C_t = A_t \left[\alpha \left(\frac{N_t^C}{q_t} \right)^{\rho} + (1-\alpha) \left(K_t^C \right)^{\rho} \right]^{\frac{1}{\rho}}, \tag{22}$$

where N_t^C and K_t^C denote labor and capital employed in the consumption sector, respectively.[25] The consumption firms' problem is:

$$\max P(q_t) C_t - w_t N_t^C - R_t K_t^C \tag{23}$$

To simplify, we abstract from quality choice in the production of investment. We assume that investment is produced by a continuum of measure one of competitive

[24] Moreover, from a theoretical point of view, in a one actor model, movement in quality will affect the actual price of investment (which will be equal to the consumption price). This would imply that we would need to model an additional channel where higher "investment quality" generate some benefits which would only, unnecessarily, complicate the analysis.

[25] We abstract from technical progress in both the consumption and investment sectors. See Appendix E for a version of the model with labor-augmenting technical progress that is consistent with balanced growth.

firms according to:

$$I_t = A_t \left[\alpha \left(N_t^I \right)^\rho + (1-\alpha) \left(K_t^I \right)^\rho \right]^{\frac{1}{\rho}}, \tag{24}$$

where N_t^I and K_t^I denote labor and capital employed in the investment sector, respectively. Note that this is a symmetric production function to the one in the consumption sector (with the exception of no quality choice).

The investment firms' problem is:

$$\max P_t^I I_t - w_t N_t^I - R_t K_t^I. \tag{25}$$

The equilibrium conditions for capital and labor are:

$$K_t^C + K_t^I = K_t, \tag{26}$$

$$N_t^C + N_t^I = K_t. \tag{27}$$

We choose the investment good as numeraire ($P_t^I = 1$). Real output (Y_t) in the economy is given by:

$$Y_t = P(q_t) C_t + I_t. \tag{28}$$

This expression assumes that real output is computed using hedonic adjustments: when the price of consumption rises, the statistical authorities recognize that this rise is solely due to an increase in the quality of the goods consumed.

We solve the model numerically, using the parameters described in Table 14, by linearizing the equilibrium conditions. We choose a high elasticity of labor supply to maximize the amplifying shocks to A_t in version of the model without quality choice. Also, to simplify, we consider the case of $\sigma = 1$ (i.e. log preferences in consumption).

Table 14: Calibration

Parameter	Moment/Description	Value
β	Discount rate	0.985
ν	Inverse of Frisch elasticity	0.001
ϕ	Match N^{SS}	5.31
θ	Elasticity of utility to quality	0.5
δ	Depreciation rate	0.025
α	Production function share	0.5
ρ	EOS between K and N: $\frac{1}{1-\rho}$	-1
ξ	AR(1) coefficient of TFP	0.95

The only new parameter in Table 14 is θ. To choose the value of $\theta,$ we compute the change in employment accounted for by changes in quality. We follow a procedure similar to the one we used in our empirical work. We define N_t^* as the employment that would occur if the quality and labor intensityare constant and equal to their steady-state values (i.e. $\frac{N}{P(q)C}$ where variables without time subscripts denote steady state values):

$$N_t^* = P(q_t)C_t \left(\frac{N}{P(q)C} \right).$$

The fraction of the change in labor accounted for by changes in quality is:

$$\psi_t = \frac{N_t^* - N}{N_t - N}.$$

We choose θ so that the average value of ψ_t computed using the first 25 quarters of the impulse response to a shock to A_t is 25 percent, a value consistent with our empirical results.

Figure 1 shows the impulse response functions of labor and output for two versions of the model: with and without quality choice. We see that the model with quality choice produces much more amplification for the reasons discussed above at the end of Section 3.1.

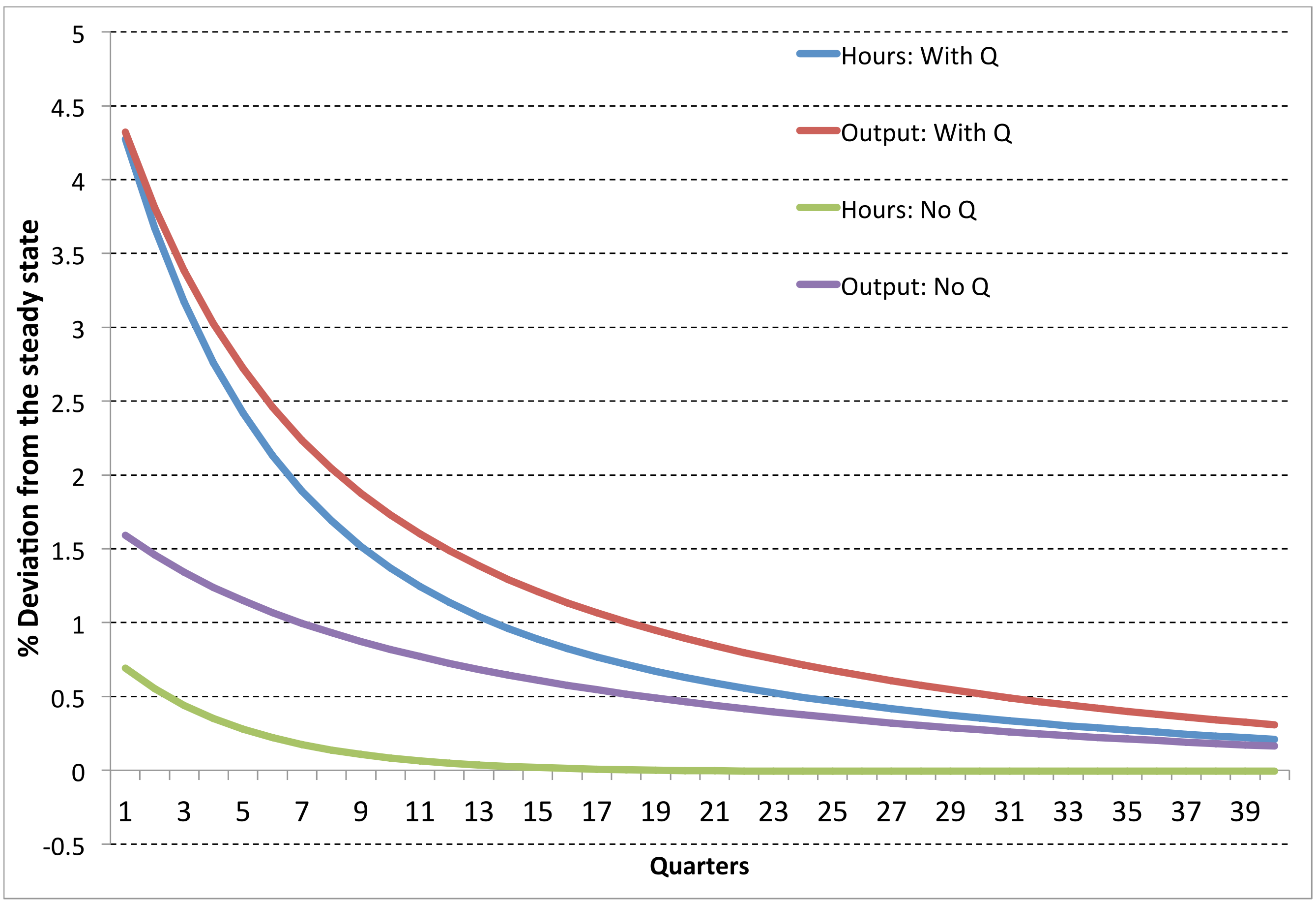


Table 15 compares the cyclical properties of quarterly U.S. data with two models driven by shocks to A_t, with and without quality choice. This table reports the variance and correlation with output for five variables: consumption, investment, total hours worked, as well as hours in the consumption and investment sectors. We see that the model with quality choice provides much more amplification of shocks to A_t than the standard model. In fact the model generates a relative variation of hours and output that is very close to the one observed in the U.S. data.

Table 15: Second Moments

Variable	Data		Model: Quality		Model: No Quality	
	$\frac{\sigma_X}{\sigma_{GDP}}$	$Cor^{X,GDP}$	$\frac{\sigma_X}{\sigma_{GDP}}$	$Cor^{X,GDP}$	$\frac{\sigma_X}{\sigma_{GDP}}$	$Cor^{X,GDP}$
Total Hours	1.1	0.78	0.98	1.00	0.42	0.95
Hours in C	0.80	0.48	0.37	0.66	0.09	-0.45
Hours in I	2.48	0.86	3.29	0.95	5.42	0.90
Consumption	0.80	0.85	0.49	0.86	0.61	0.94
Investment	3.16	0.87	3.47	0.96	5.92	0.93
Labor Wedge	1.1	-0.69	0.37	-0.86	NA	NA

Comovement

Table 15 shows another interesting difference between the two models. As emphasized by Christiano and Fitzgerald (1998), hours worked in the consumption sector are procyclical in the data but countercyclical in the standard model.[26]

[26]To classify the sectors into "consumption" and "investment" we follow standard practice. Specifically, we use BEA 2002 benchmark I/O "use tables". From it we compute the share of sectoral output

The model with quality choice generates procyclical hours worked in the consumption sector.

To understand this property it is useful to write the first-order condition for labor choice for the standard model assuming that the production function is Cobb-Douglas:

$$\phi\left(N_t^C + N_t^I\right)^{\nu} = \frac{\alpha}{N_t^C}.$$

It is clear that N_t^I and N_t^C are negatively correlated, so that N_t^I and N_t^C cannot be both positively correlated with aggregate output. Using a CES production function changes the form of the first-order condition but does not help generate comovement.

Now, consider the first-order condition for labor choice in the model with quality choice:

$$\phi\left(N_t^C + N_t^I\right)^{\nu} = \frac{q_t^{1-\theta-\rho}}{1-\theta}\frac{\alpha}{\left(N_t^C\right)^{1-\rho}}\left(\frac{A_t}{C_t}\right)^{\rho}.$$

This equation shows that N_t^C and N_t^I can be positively correlated because, when these variables rise, quality increases. The intuition for why comovement can occur is that the rise in quality increases the demand for labor in the consumption sector contributing to comovement between N_t^C and N_t^I.

An endogenous labor wedge

Shimer (2009) modifies the standard Euler equation for labor to allow for a "labor wedge," τ_t, that acts like a tax on the labor supply:

$$\phi N_t^{\nu} = (1-\tau_t)\frac{1}{C_t}w_t. \tag{29}$$

Shimer computes the labor wedge, using empirical measures of N_t, C_t, and w_t. He finds that τ_t is volatile and counter-cyclical: workers behave as if they face higher taxes

that is used for private consumption vs. private investment. We assign a sector to be consumption (investment) if its share in final output is greater than the share that goes to investment (consumption). For the hours/sectors data we use the Current Employment Statistics 1964:Q1 - 2012:Q4 on labor income in recessions than in expansions. Comparing equations (30) and the resulting experience in our model

$$\phi N_t^{\nu} = \frac{q_t^{1-\theta}}{1-\theta} \frac{1}{C_t} \frac{w_t}{P(q_t)}. \tag{30}$$

Since quality choice is pro cyclical it can generate an endogenous counter-cyclical labor wedge. Indeed this can be seen in Table 15.

Summary

To summarize, we find that the the introduction of a quality choice into an otherwise standard model gives rise to major fluctuations in hours worked. This enables the model to match the overall relative variability of hours to output that is observed in the U.S. data. Moreover, the model can also account for the sectoral comovement in hours worked.

4 A sticky-price model

The previous section showed that a quality choice magnifies the effect of real shocks. In this section we show that it also magnifies nominal shocks. To show this we embed a quality choice in an model with Calvo (1983) style sticky prices.

4.1 The household problem

The representative household maximizes expected life-time utility defined in equation (18).

The two constraints on the household problem are:

$$P(q_t)C_t + B_{t+1} = B_t\,(1 + R_t) + w_t N_t, \tag{31}$$

and

$$E_0 \lim_{t\to\infty} B_{t+1}/[(1 + r_0)(1 + r_1)...(1 + r_t)] \geq 0.$$

Here, B_{t+1} the number of one-period nominal bonds purchased at time t, and R_t is the one period nominal interest rate. Note that to highlight the role of quality choice in a parsimonious way, we abstract from capital accumulation.

The first-order conditions for the household are two equations associated with the static model (Equations (13) and (14)), together with the following additional condition:

$$\lambda_t = E_t \beta \lambda_{t+1} \left(1 + R_{t+1}\right). \tag{32}$$

Final good firms

The final good is produced by competitive firms using a continuum of intermediate goods, $Y_t^i(q_t)$:

$$Y(q_t) = \left(\int_0^1 \left[Y_t^i(q_t) \right]^{\frac{\varepsilon - 1}{\varepsilon}} di \right)^{\frac{\varepsilon}{\varepsilon - 1}}, \ \varepsilon > 1. \tag{33}$$

We assume that producing a final good of quality q_t requires using intermediate inputs which all have quality q_t.

The problem of firms in the final-goods sector is:

$$\max P(q_t) Y(q_t) - \int_0^1 P_t^i(q_t) Y_t^i(q_t) \, di,$$

where $P_t^i(q_t)$ is the price of intermediate good i. The first-order conditions of the firms' problem imply :

$$P_t^i(q_t) = P(q_t) \left[\frac{Y(q_t)}{Y_t^i(q_t)} \right]^{\frac{1}{\varepsilon}}, \tag{34}$$

where P_t is the price of the homogeneous final good. Using the first-order conditions of the firms' problem we can express this price as:

$$P(q_t) = \left(\int_0^1 P_t^i(q_t)^{1-\varepsilon} \, di \right)^{\frac{1}{1-\varepsilon}}$$

Intermediate Good Firms

The ith intermediate good is produced by a monopolist using a technology that is the limiting case of the flexible price model without capital:

$$Y_t^i(q_t) = \frac{A_t}{q_t} N_t^i(q_t). \tag{35}$$

Here, $N_t^i(q_t)$ denotes the labor employed by the i^{th} monopolist who is producing a product of quality q. If prices were flexible, the optimal price for the ith monopolist would be given by the usual mark-up formula:

$$P_t^i(q_t) = \frac{\varepsilon}{\varepsilon - 1} \frac{w_t}{A_t} q_t.$$

However, producers are subject to Calvo-style pricing frictions. We assume that monopolists post a pricing schedule that is linear in q_t:

$$P_t^i(q_t) = \mu_t^i q_t.$$

The monopolist can re-optimize the entire pricing schedule μ_t^i with probability $1 - \xi$. With probability ξ, the firm has to post the same price schedule as in the previous period:

$$P_t^i(q_t) = \mu_{t-1}^i q_t.$$

We denote by $\tilde{\mu}_t^i$ the optimal price-quality schedule for firms that have the opportunity to re-optimize μ_t^i at time t. Since only a fraction $1-\xi$ of the firms have this opportunity, the aggregate price level is given by:

$$P(q_t) = \mu_t q_t, \tag{36}$$

where

$$\mu_t = \left[(1 - \xi)\left(\tilde{\mu}_t^i\right)^{1-\varepsilon} + \xi \mu_{t-1}^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}. \tag{37}$$

Firm i chooses $\tilde{\mu}_t^i$ to maximize its discounted profits, given by:

$$E_t \sum_{j=0}^{\infty} \beta^j \lambda_{t+j} \left[P_t^i \left(q_{t+j}\right) Y_t^i \left(q_{t+j}\right) - w_{t+j} N_t^i \left(q_{t+j}\right) \right], \tag{38}$$

subject to the Calvo price-setting friction, the production function, and the demand function for $Y_t^i\left(q_t\right)$.

Given that the price schedule is linear in quality, the demand function for $Y_t^i\left(q_t\right)$ can be written as:

$$\tilde{\mu}_t^i = \frac{P(q_t)}{q_t} \left[\frac{Y(q_t)}{Y^i\left(q_t\right)} \right]^{\frac{1}{\varepsilon}}. \tag{39}$$

Since the price schedule chosen at period t is only relevant along paths in which the firm cannot reoptimize its schedule, the firm's problem is given by:

$$E_t \sum_{j=0}^{\infty} \beta^j \xi^j \lambda_{t+j} q_{t+j}^{1-\varepsilon} \left[P(q_{t+j})\right]^{\varepsilon} Y(q_{t+j}) \left[\left(\tilde{\mu}_t^i\right)^{1-\varepsilon} - w_{t+j} \frac{\left(\tilde{\mu}_t^i\right)^{-\varepsilon}}{A_{t+j}} \right].$$

Following the usual procedure to solve Calvo-style models we obtain the following modified Phillips Curve:

$$\widehat{\pi}_t = \frac{(1-\beta\xi)(1-\xi)}{\xi} \left[\theta \widehat{N}_t\right] + \beta \widehat{\pi}_{t+1}, \tag{40}$$

and the following intertemporal Euler condition:

$$\left(\hat{N}_{t+1} - \hat{N}_t\right) = \frac{-rr + r_{t+1} - \hat{\pi}_{t+1}}{\theta}. \tag{41}$$

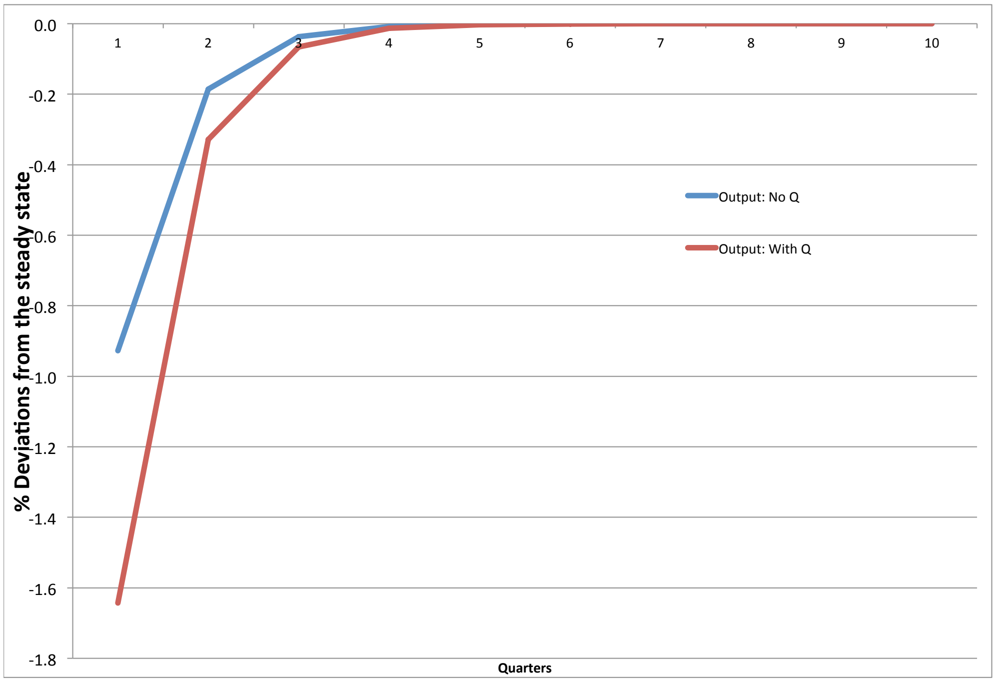
It is useful to compare these two equations with those associated with a version of the model with no quality choice:

$$\widehat{\pi}_t = \frac{(1-\beta\xi)(1-\xi)}{\xi} \left[\widehat{N}_t\right] + \beta \widehat{\pi}_{t+1}, \tag{42}$$

$$\left(\hat{N}_{t+1} - \hat{N}_t\right) = -rr + r_{t+1} - \hat{\pi}_{t+1}. \tag{43}$$

Comparing these equations with the ones for the model with quality choice we see that, since $\theta < 1$, the latter model produces a higher response to the monetary shock than the former. This difference in amplification is illustrated in Figure 2.[27]

[27] We keep the same parameter values for β, θ, and ν as in the flexible price model. We set the "Calvo" parameter $\varepsilon = 0.75$ and we assume a monetary policy rule where the coefficient on inflation equals 1.5.



To understand this difference, it is useful to consider first a flexible-price version of the model without quality choice. In this model, if the central bank raises the nominal interest rate, the price level falls and inflation rises leaving the real interest rate unchanged. As a result, the change in nominal interest rates has no effect on real variables.

Now consider the model with sticky prices but no quality choice. When the central bank raises the nominal interest rate, only a few firms can lower prices. As a result, the real interest rate rises. This rise in the real interest rate makes households want to consume less today and more in the future. The current demand for consumption falls and, since employment is demand determined, hours fall.

The key difference between the model with and without quality choice is that the former exhibits a stronger response of the labor supply to shocks. As a consequence, the wage rate has to fall more to clear the labor market than in the standard model. The rate of inflation becomes more negative than in the standard model, as firms lower prices in response to the lower labor costs. This higher rate of deflation implies that the real interest rate is higher in the model with quality choice than in the standard model. This higher real interest rate is associated with a larger fall in consumption, as households postpone consumption to take advantage of the high real interest rate. The result is a larger fall in employment in the quality-choice model than in the standard model.

5 Conclusion

In this paper, we show that when consumers suffer a reduction in their income, they trade down in the quality of the goods and services they consume. We also show that lower quality products are generally less labor intensive, so trading down reduces the demand for labor. Our calculations suggest that trading down accounts for 25 to 35 percent of the decline in employment during the recent recession.

We introduce quality choice in both flexible and sticky macro models. In these models, consumers trade-up in the quality of what they consume in expansions and trade down in recessions. This behavior amplifies the effects of both real and monetary shocks.

We find that introducing quality choice improves the performance of business cycle models along two dimensions. First, it generates comovement in labor in consumption and investment goods sectors. Second, it generates an endogenous countercyclical labor wedge that improves the ability of the model to explain the behavior of hours worked in the data.

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Appendix A

A Yelp!

For firms that own more than one brand, we compute the average price category for each brand and then compute the average price category for the firm, weighting each brand by their sales volume. One concern about this procedure is that we might be averaging high-quality and low-quality brands. In practice, this situation is rare: 73 percent of the firms in our sample have a single brand. For multi-brand firms, 54 percent have all their brand in the same price category. For example, the firm Yum! Brands owns three brands (Taco Bell, KFC, and Pizza Hut), but they are all in the same price category (low price). For robustness, we redid our analysis including only firms that either have a single brand or have all their brands in the same price category. We obtain results that are very similar to those we obtain for the whole universe of firms.

In merging the data with Compustat we note that for companies with operations outside of the U.S., we use the information on sales by business region to compute U.S. sales. We also use the break down of employment by business region to compute labor intensity in the U.S. We exclude from our sample manufacturing firms for which this breakdown is not available. For retail firms, foreign operations are generally small, so we include companies with foreign operations in our sample. As we robustness check, we redo our analysis excluding these companies. The results are similar to those we obtain for the full sample.

Table 16 presents some description of the data used to analyze quality shifts in expenditure in six retail sectors. It describes the data source (column I), the number of firms covered in the sample in 2007 (II), the average annual firm sales revenue (III), and the percent of the overall sector sales that our sample covers (IV).

Table 16: Data Sample Description

Sectors	Data Source	Number of Firms	2007 Annual Sales of Average Firm ($m)	% of U.S. Sector
	(I)	(II)	(III)	(IV)
Accomodation	Compustat and company reports	11	3,088	15%
Apparel	Compustat and company reports	54	1,648	41%
Grocery stores	Compustat and company reports	9	34,348	56%
Restaurants	Compustat and company reports	74	1,012	19%
Home furnishing	Compustat	41	4,750	39%
General Merchandise	U.S. Census	n.a.	n.a.	100%

B PPI

Using the PPI data presents two challenges. First, in the PPI, firms in the same industry report prices that correspond to different units of measurement, e.g. some firms report price per pound, others price per dozen. To circumvent this problem we compute the modal unit of measurement for each six-digit category and restrict the sample to the firms that report prices for this model unit. This filtering procedure preserves 2/3 of the original data, which is comprised of 16,491 establishments out of a sample of about 25,000 establishment surveyed by the PPI.[28]

Second, some of the firms included in the PPI data offshore their production, so their reported employment does not generally include production workers. It includes primarily head-office workers and sales force in the U.S. Using information in the firms' annual reports, we exclude firms that have most of their production offshore. The

[28]Note some establishments are excluded because we only include items that are recorded at the modal unit of measure within the 6-digit product category.

resulting data set preserves over half of the merged PPI/Compustat data.

C Indirect effects of trading down on employment

The total change in employment accounted for by trading down is the sum of two components: (i) the direct effect of quality shifts on employment within the same sector, and (ii) the indirect effect on employment in other sectors that provide intermediate inputs to the sector that experienced trading down.

Indirect effects can arise from differences in the required total inputs per unit of output across quality tiers. For instance, suppose that low-quality restaurants require fewer inputs produced by other (non-restaurant) sectors than higher-quality restaurants. In this case, a shift from high to low quality not only affects employment within the restaurant sector, but also reduces the amount of inputs that need to be produced by other sectors and subsequently labor in those sectors.

We measure these indirect effects of trading down on employment in a way that is comparable to how the Bureau of Economic Analysis (BEA) constructs its "Total requirements tables." The BEA tables describe how a change in inputs required by one sector affects the outputs of other sectors. Specifically, we calculate

$$\sum_{j\in\mathbf{J}}\sum_{l\in\mathbf{J}}\left[\frac{N_j}{\text{Output}_j}\right]_{2012}\cdot[\triangle\text{Output in } j \text{ due to quality shifts within } l] \tag{1}$$

where the term $[\mathrm{N}_j/\text{Output}_j]_{2012}$ refers the number of employees per dollar value of output in sector j in 2012. The second term refers to the change over 2007-2012 in the value of output produced by sector j as inputs for sector l due to quality-related shifts in market shares within sector l. The second term is computed as

$$g_{lj,2012}\cdot\left[\text{Output}_{l,2012}\cdot\sum_{i(l)\in\mathbf{Q}}\triangle\text{Market share}_{i(l)}\cdot\left(\frac{\text{Input}_{i(l)}}{\text{Output}_{i(l)}}\right)_{2012}\right] \tag{2}$$

The first term, $g_{lj,2012}$, denotes the change in output of sector j given a dollar change in total inputs required by sector l (from any sector) in 2012. The second (bracketed) term represents the magnitude (in dollars) of the change in total inputs required by sector l related to shifts in the market shares of the quality tiers within sector l. Therefore, the product of the two gives the change in output required by sector j due to shifts in quality within sector l.

We obtain data for the first term of Equation (2) directly from the BEA "Total Requirements Industry by Industry" table, and construct the empirical counterpart of the second (bracketed) term using data from Compustat, the BLS and the BEA. We use Compustat data to compute $\triangle \text{Market share}_{i(l)}$ as defined in (**??**). The term $(\text{Input}_{i(l)}/\text{Output}_{i(l)})$ denotes the revenue-weighted average input-output ratio for firms in quality tier i within sector l in 2012. We construct the empirical counter-parts of the inputs and outputs of each firm to be consistent with the definitions in the BEA Total Requirements tables. Specifically, the dollar value of output is computed as

$$\text{Output}_{i,2012} = \text{Operating expenses}_{i,2012} - \text{Cost of goods sold}_{i,2012}$$

and the value of the inputs is defined as

$$\text{Input}_{j,2012} = \text{Operating expenses}_{j,2012} - \text{Cost of goods sold}_{j,2012} - \text{Labor costs}_{j,2012}$$

The operating expenses and cost of goods sold are from Compustat. The labor costs of firms within the Compustat data, however, is sparsely available since firms are not required to publicly report this item in their annual reports. Therefore, we instead estimate the labor costs of each firm using the number of employees reported at a firm-level (from Compustat) multiplied by the sector-wide average annual wage (from the BLS). The change in the input-output ratio is then multiplied by the dollar value of output in sector l in 2012, to give the change in the dollar value of output produced by sector j due to quality shifts in sector l.

D Quality being a normal good

To see that quality is a normal good we proceed as follows. The first order condition for quality is given by

$$log(C(q_t)) = \frac{1}{1-\theta}\frac{q_t}{P(q_t)}P'(q_t)$$

By definition in the static model income is given by

$$Y = C(q)P(q)$$

Then, substituting the ÒincomeÓ condition implies

$$log(Y) = log(P(q)) + \frac{1}{1-\theta}\frac{q_t}{P(q_t)} * P'(q_t)$$

Assume that income goes up. Given the CES production function the last equation can be written as

$$log(Y) = log(\frac{1}{Z}) + \frac{\rho-1}{\rho} log\left[\alpha^{\frac{1}{1-\rho}}\left(\frac{1}{q}\right)^{\frac{\rho}{1-\rho}} w^{\frac{\rho}{\rho-1}} + (1-\alpha)^{\frac{1}{1-\rho}} r^{\frac{\rho}{\rho-1}}\right] + \frac{1}{1-\theta}\frac{1}{1+(\frac{1-\alpha}{\alpha})^{\frac{1}{1-\rho}}\left(\frac{r}{wq}\right)^{\frac{\rho}{\rho-1}}}$$

Note that the first term

$$log\left[\alpha^{\frac{1}{1-\rho}}\left(\frac{1}{q}\right)^{\frac{\rho}{1-\rho}} w^{\frac{\rho}{\rho-1}} + (1-\alpha)^{\frac{1}{1-\rho}} r^{\frac{\rho}{\rho-1}}\right]$$

increases with quality. Similarly, the second term

$$\frac{1}{1-\theta}\frac{1}{1+(\frac{1-\alpha}{\alpha})^{\frac{1}{1-\rho}}\left(\frac{r}{wq}\right)^{\frac{\rho}{\rho-1}}}$$

increases with quality as well implying that as income (i.e. Y) goes up then the optimal choice of quality increases.

E Balanced growth

In this appendix we show that a modified version of the flexible price model is consistent with balanced growth. The economy's planner's problem is:

$$\max U = \sum_{t=0}^{\infty} \beta^t \left\{ \frac{q_t^{1-\theta}}{1-\theta}\frac{(C_t/X_t)^{1-\sigma}-1}{1-\sigma} - X_t^{1-\theta}\phi\frac{N_t^{1+\nu}}{1+\nu} \right\},$$

s.t.

$$C_t = A_t \left[\alpha \left(\frac{X_t^2 N_t^C}{q_t} \right)^{\rho} + (1-\alpha) \left(K_t^C \right)^{\rho} \right]^{\frac{1}{\rho}}, \tag{3}$$

$$K_{t+1} = A_t \left[\alpha \left(X_t N_t^I \right)^{\rho} + (1-\alpha) \left(K_t^I \right)^{\rho} \right]^{\frac{1}{\rho}} + (1-\delta) K_t, \tag{4}$$

$$N_t^C + N_t^I = N_t,$$

$$K_t^C + K_t^I = K_t.$$

Making the utility function compatible with balanced growth requires two modifications. The first is to scale the disutility of labor by $X_t^{1-\theta}$. Otherwise, since the same amount of labor can produce more output over time, labor effort increases over time. We can interpret $X_t^{1-\theta}$ as representing technical progress in home production. The second modification is that $C_t^{1-\sigma}$ needs to be replaced with $(C_t/X_t)^{1-\sigma}$. This modification resembles Abel's (1990) external habit formulation.

In order for quantities to grow at a constant rate in the steady state we need, as usual, labor-augmenting technical progress. If the production function for consumption takes the form:

$$C_t = A_t \left[\alpha \left(\frac{X_t N_t^C}{q_t} \right)^{\rho} + (1-\alpha) \left(K_t^C \right)^{\rho} \right]^{\frac{1}{\rho}},$$

C_t grows in the steady state at the same rate as X_t but the quality of the goods consumer, q_t, remains constant. In order for both C_t and q_t to grow at the same rate as X_t we need labor-augmenting technical progress to depend on X_t^2 as in equation (3).

It is easy to see that the resource constraints (3) and (4) are consistent with C_t, q_t, and K_t growing at the same rate as X_t.

To show that the modified model is consistent with balanced growth, we use the first-order conditions for the planner's problem. Combining the first-order condition for C_t and q_t we obtain:

$$\frac{(C_t/X_t)^{1-\sigma}-1}{1-\sigma} = \frac{1}{1-\theta}\frac{q_t}{C_t}A_t\left[\alpha\left(\frac{N_t^C}{q_t/X_t}\right)^{\rho}+(1-\alpha)\left(K_t^C/X_t\right)^{\rho}\right]^{\frac{1-\rho}{\rho}}\alpha\left(N_t^C\right)^{\rho}(X_t/q_t)^{1+\rho}.$$

Combining the first-order condition for N_t and C_t we obtain:

$$\left(\frac{X_t}{q_t}\right)^{1-\theta}\phi N_t^{\nu} = \frac{q^{1-\theta}}{1-\theta}\left(\frac{C_t}{X_t}\right)^{-\sigma}A_t\left[\alpha\left(\frac{N_t^C}{q_t/X_t}\right)^{\rho}+(1-\alpha)\left(\frac{K_t^C}{X_t}\right)^{\rho}\right]^{\frac{1-\rho}{\rho}}\alpha\left(\frac{1}{q_t/X_t}N_t^C\right)^{\rho}\left(N_t^C\right)^{-1}.$$

Both equations are consistent with C_t, q_t, and K_t growing at the same rate as X_t.