of reservation prices. So, demand will increase smoothly as a seller lowers the price.

What are the major conclusions that can be drawn from these equilibrium models of price dispersion? The first is that both social and consumer welfare are typically decreasing with search costs. A reduction in search costs for some consumers can have a positive externality on other consumers, as increased search brings down prices for all. Other predictions can sometimes be counterintuitive. For example, an increase in the number of sellers actually raises the average price charged in the Varian model. However, this result does not hold for all price dispersion models. Further, Baye, Morgan and Scholten (2004) find empirically that both average prices and the degree of price dispersion fall with an increase in seller numbers. Finally, we have seen that models with homogenous sellers give rise to mixed equilibria, while models with bilateral heterogeneity can generate pure equilibria. Randomization over prices would imply regular change in price order amongst sellers. That is, sometimes a given seller would have the highest price, sometime the lowest, and sometimes in the middle. A monotone pure equilibrium would give rise to a stable price ranking. Baylis and Perloff (2002) find that price ranking on online sales of electronic goods are very stable. In contrast, Lach (2002) finds that price ranking in data on prices charged by different Israeli supermarkets is highly variable.

One possibility is that the difference arises because Lach's data are for groceries that are purchased with greater frequency than the electronic goods in Baylis and Perloff's data set. But this highlights that the current theoretical literature on price dispersion has rarely addressed the related issues of repeat purchases, frequency of purchase and search patterns that depend on past experience, for example returning to sellers that have had low prices before. This would seem the area that is in most the need of further research.

ED HOPKINS

See also **oligopoly; price discrimination (theory); search theory.**

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Price Revolution

The Price Revolution, dating from about 1515 to the 1650s, was a long period of persistent inflation in Europe that was unique for the pre-20th-century economy. The sustained rise in prices, or rather in the Consumer Price Index (CPI) is clearly visible in Figure 1 for English prices from 1266 to 1954 (base 1451–75 = 100), and in Figure 2 for prices in southern England, the southern Low Countries (Brabant), and Spain, from 1501 to 1650. With a common base of 1501–10 = 100 (CPI) for all three regions, we find that, over the next century and a half to 1646–50, the index number for Spanish prices rose to 343; for Brabantine prices, to 845; and for English prices, to 698.

Average annual rates of price increases of less than two per cent in the Price Revolution era may have been mild in comparison with 20th-century inflations: but all pre-20th century inflations were based on commodity moneys, not government issues of fiat money, as in the modern world. Before 1914, western Europe experienced, to be sure, other periods of long-term inflation, particularly, if only periodically, during the 'long' 13th century (1180–1315) and in the early Industrial Revolution era (1760–1815). But these produced price-level changes that were far smaller than those of the Price Revolution.

All long-term inflations are fundamentally monetary in nature, even though secondarily influenced by real factors. That may be best understood through the Cambridge cash balances equation, $M = k.P.y$, in which k indicates the quantity of cash balances (high-powered money M) held as a proportion of net national income (y). It is also the inverse of V, the income velocity of money, in the more familiar quantity-theory equation: $M.V = P.y$. Since the opportunity cost of holding cash is forgone interest income, changes in k should therefore depend partly on interest rates. Though an increase in M (money stocks) may prove inflationary, the equation indicates why the extent of such inflation is unpredictable. For such an increase in P can be offset by a rise in k

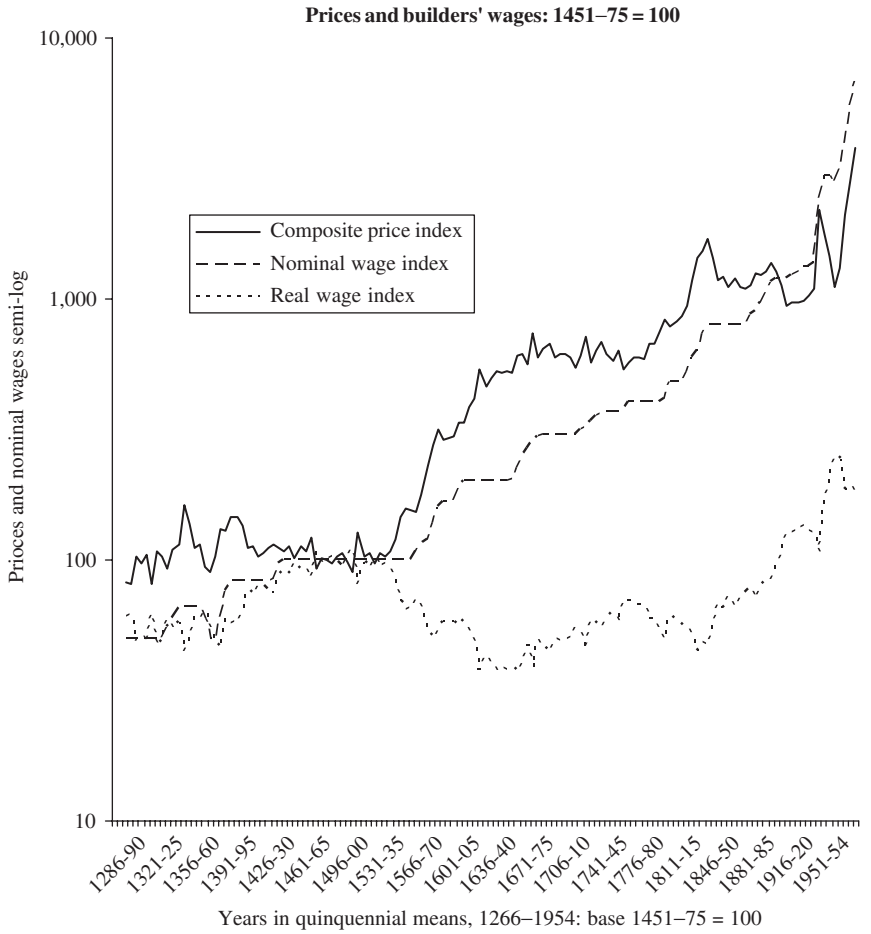

Figure 1 Consumer prices and wages for master building craftsmen in southern England, in quinquennial means: 1266–1954 (Phelps Brown and Hopkins indices). *Source:* Phelps Brown and Hopkins (1981, pp. 13–59).

(especially if an increased *M* reduces interest rates), that is, a fall in *V*, or by an increase in *y*, stimulated by increased spending and falling interest rates.

Demographic versus monetary explanations

Regrettably, amongst historians population growth has provided the most popular explanation for the Price Revolution. Contemporary explanations for the Price Revolution, especially in the debate between the French philosophers Jean Bodin and Jean Malestroit (1568), were instead purely monetary: that is, concerning the influx of Spanish-American silver during the 16th and 17th centuries. Modern opponents of this thesis have, however, rightly pointed out that virtually no American silver was imported before the 1530s, and only insignificant volumes were received before the 1560s, while inflation was clearly under way by 1515–20.

Yet to assume that consequently demographic factors provide the only possible alternative explanation is an absurd non-sequitur. There are two major problems with the demographic thesis. First, its most common form confuses microeconomic with macroeconomic changes. Although population growth, with fixed amounts of land and a static technology, should lead to a rise in the *relative* price of grains compared with those for manufactures, it can not explain a rise in the general price level. Second, the populations of both England and the Low Countries in the 1520s were at their late-medieval nadir, about half of what they had been around 1300 (when the English CPI was only 102); and thus any demographic recovery from such a low level could not possibly have provided the initial cause of an inflation that was under way in that very same decade.

The actual origins of the European Price Revolution lie instead in alternative monetary explanations, commencing

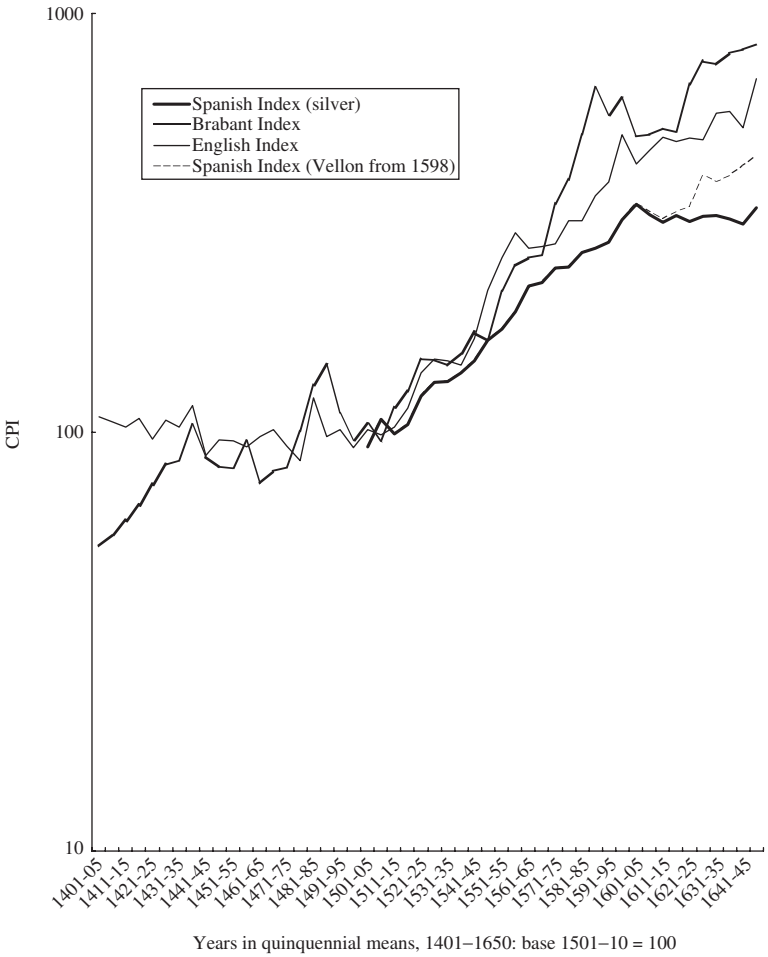

Figure 2 Price indexes: England, Brabant, and Spain, 1401–1650. *Source:* England, as Figure 1. Brabant, Van der Wee (1975, pp. 413–35). Spain, Hamilton (1934; pp. 262–403).

with the central European silver-copper mining boom in the 1460s. This was an era of severe deflation (in silver-based prices) that had thereby augmented the purchasing power of silver and provided the key profit incentives for two crucial technological innovations: (*a*) in mechanical engineering: water-powered piston drainage pumps that permitted deeper mining, reaching richer ores; and (*b*) in chemical engineering, the *Saigerhütten* process using lead to smelt silver–copper ores, thus for the first time separating the two metals, which were present in vastly larger ore bodies than those of silver alone. The resulting silver–copper mining boom increased aggregate output of European mined silver about fivefold by the 1540s, producing far more silver than was imported from the Americas until the 1580s. By my own conservative estimates, central European silver production itself rose from an average annual of 12,873 kg in 1471–5 to 55,704 kg in 1536–40.

As late as 1556–60, only 27,145 kg of American silver were imported yearly into Seville; but in 1566–70 annual mean imports jumped to 83,274 kg, thanks to another technological innovation: the mercury amalgamation method, employed first at Potosi (Peru) and Zacatecas (Mexico). Thereafter, rising imports, reaching a maximum of 273,821 kg per year in 1591–5, but still amounting to an impressive 223,023 kg per year in 1621–5, continued to fuel the inflation. When the Price Revolution ended in 1656–60, silver imports had diminished to an annual mean of just 27,965 kg. Spanish-American mines were then experiencing severely diminishing returns, while far more metal was being retained for use in the Americas, and more and more silver was being exported across the Pacific, in trade with the Philippines and China.

There was one additional monetary factor to explain the European Price Revolution, namely, a veritable

financial revolution in the Habsburg Netherlands, whose towns (from 1507) and then the Estates General (1539–43) established all the legal requirements for negotiability, including legalization of interest and discounting, to protect the rights of third parties in transferable bills, so that bills obligatory and bills of exchange could circulate from hand to hand in commercial and financial transactions as though they were paper money. This financial revolution also established full-fledged negotiability and thus far wider use of government debt instruments, internationally traded on the Antwerp *beurse* from 1531, as perpetual annuities known as *rentes* or *juros*. One measure of their vastly growing importance is the increased issue of Spanish *juros,* from 3.6 million ducats in 1516 to 80.4 million ducats in 1598, most of them held abroad. This financial revolution also increased the income velocity of high-powered money.

Demography and the income velocity of money

Just the same, demographic factors are not irrelevant to our understanding of the dynamics of the Price Revolution, not when population growth became so much more dramatic from the 1540s to the 1640s. First, in various ways that have been elaborated by Harry Miskimin (1975), Jack Goldstone (1984) and Peter Lindert (1985), that population growth, combined with more urbanization, the development of more complex commercial and financial networks, and changes in the age pyramid (with more dependants), may have increased the income velocity of money. Furthermore, as Nicholas Mayhew (1995) has shown, the Keynesian predictions of a fall in income velocity with continued expansions in monetary stocks (and falls in interest rates) seems to hold true from the 13th to the 20th century, with one singular exception: the Price Revolution era.

The role of coinage debasements

Finally, what explains the differences in the inflation rates revealed across the three countries in Figure 2: why did Spanish prices rise less than English, and English prices rise less than Brabantine? Coinage debasement (depreciation) seems to have played a role in these differences. Spain experienced no silver coinage debasement. England experienced one mild coinage debasement, in 1526, and one set of very severe debasements between 1542 and 1552 (though the silver coinage was only partially restored, in 1560–61); but none thereafter. Brabant, on the other hand, suffered a long series of coinage debasements, during the 16th and 17th centuries. Thus, the explanations for the European Price Revolution involve a complex set of monetary and real factors, though monetary factors predominated.

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See also **Bodin, Jean; commodity money; cost-push inflation; demand-pull inflation; depreciation; economic demography; Fisher, Irving; hyperinflation; inflation; inflation measurement; Keynes, John Maynard; monetary economics, history of; money; money supply; population dynamics.**

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