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Cigarette Money and Black Market Prices around the 1948 German Miracle

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Vincent Bignon *

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Abstract

This paper is an empirical study of the distribution of black prices among 120 Bavarian locations at two dates, the beginning of July, 1947 and the end of June, 1948. It shows huge differences in the liquidity of those goods either when measured with the coefficient of variation or the number of locations in which those goods were traded. The main finding is that liquidity of cigarette was very high either when measured by the coefficient of variation and or the number of counties that traded them. This made them special, even when compared with a pure fiat object such as the US dollar. Consistently with the insights of the modern theory of money, the high liquidity of cigarettes is indicative of its use as money.

The use of cigarette to pay for illegal trades in Europe during the 1940's is one of the most popular and often cited examples of the use of commodity money in modern times (Senn, 1951, Klein, 1976). Yet our knowledge rests mostly on qualitative evidences that indicate its wide use in prisoners' camp (Radford, 1945), in post World War II Europe¹ (Rosen, 1947) and especially in post war Germany (Friedman 1951, Kindleberger, 1984). This paper provides quantitative evidences on the cigarette money episode by using a sample of black market prices to compute the liquidity of the eight goods of the sample and to show that the liquidity of cigarettes was far higher than that of any other goods.

Starting with Kiyotaki and Wright (1989) and drawing on the work of nineteenth century economists such as Menger (1892), the recent monetary theory had shown that the bigger liquidity of money is linked to its role of medium of exchange in the exchange process rather

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¹ Although the following quote indicates that Germany was unique: “While the American cigarettes will fetch a high price in almost every country of Europe, it is only in Germany that it has been elevated to the dignity of a medium of exchange” in “The Cigarette standard” published by the Herald Tribune (2/28/1947)

than its issuance by the State. Burdett, Trejos and Wright (2001) applied this very general argument to the use of cigarettes as a medium of exchanges. Yet no empirical proof of this statement exists because any money that circulated in history was issued by a State or a Sovereign. Because cigarettes in post war Germany were not issued by any State and because it was illegal to use them in payments, this paper then constitutes the first empirical assessment of the statement that the liquidity of money comes from its sole role of medium of exchanges. To prove this point, I use an original dataset of black market prices for eight goods in 120 Bavarian locations out of 143 in July 1947 and June 1948 to study various statistics of the liquidity and finds that the liquidity of cigarettes was highest.

Two main criteria are used to measure liquidity: 1) a coverage ratio measuring the probability that a given good is sold on a given black market and 2) the price dispersion across locations. The first criteria indicated that cigarettes, like butter or coffee, benefited from a wide coverage while US dollars or the Military payment coupon– the two fiat objects– were quoted in only half of the counties. But the price dispersion was far lower for cigarettes than all the other goods, even when compared with fiat objects that were perfectly homogenous in quality. This shows that using cigarettes to trade on local black market reduced two types of risk: 1) the risk of not being able to sell the holding and 2) the risk to lose on the prices paid because of price dispersion. As monetary theory predicts, these two characteristics can be linked to the monetary use of cigarettes. The paper also tackles with two important issues. First it provides an explanation of why Germans switched from using a fiat currency (the Reichsmark) to an economy with barter and commodity money. Second, the interpretation of the level of price dispersion as an indicator of liquidity can hold only if black markets were integrated (i.e. people arbitrated among markets). The last section therefore tests whether the variance of the sample of prices can be explained by some type of markets' segmentation. The results clearly allow rejecting this hypothesis.

While a few papers also studied the cigarette money episode, they mainly rested on qualitative evidences (Radford, 1945) or provided seldom mentions of the price range of cigarettes (Schmölders 1973, Botting, 1985, Bub, 2004). Rosen (1947) is the sole paper that also uses black prices to study the demand for cigarettes in 1945 Austria. Drawing on time series, he showed that the evolution of the cigarettes' price on the Vienna's black market was correlated with the price of the U.S. dollar before the monetary reform of December, 1945 but not after. He interpreted this switch as evidence of the change in the motive of the demand of cigarettes and concluded that this is explained by the cigarettes losing their monetary function with the stabilization. Although interesting, this analysis is somewhat questionable as no proof was provided that the dollar was a medium of exchanges *in Austria* and not just an asset. Therefore the correlation could only have meant that cigarettes were a kind of asset before the stabilization but not after. This would have be the case if people chose before December 1945 to keep their wealth into real goods or foreign currencies rather than fiat money. To avoid this difficulty, this paper uses a different approach and measures the liquidity of goods on a spatial basis. It shows that the behaviour of the prices of dollar and cigarettes differed sharply from 1945 Vienna (which is only 400 kilometres away).

The rest of the paper is organized as follows. Section 1 explained the emergence of a barter economy. Section 2 presents the theoretical literature and the dataset. Section 3 shows that the liquidity of cigarettes was far higher than the liquidity of any other goods. Section 4 rules out the hypothesis that local markets were segmented. The last section concludes.

1. The emergence of a barter economy in post war Germany

The emergence of commodity moneys has roots in the institutional and economic background of the German economy. On the institutional side, the Allies continued the system introduced during the war to deal with shortages of civil goods and to prevent inflation. Two major shifts adversely affected the efficiency of this system and lead to the emergence of a

barter economy. First the fiat money lost his value not because of inflation but rather by lack of sold goods. Second the rationing system failed to provide an adequate standard of living.

1.1. Caloric value in the rationing system and the rise of black market transaction

The distribution of food and clothes was primarily done through a rationing system in which consumers gained the right to purchase a predetermined quantity in the regular network of shops against a given amount of rationing tickets and a money payment in Reichsmarks. The quantities of the rationed goods sold were set each month by an authority that allocated the available production among the various groups of consumers. Therefore the caloric value distributed hinged primarily upon the level of production and the deliveries of the producers.

Figure 1 shows that between August 1945 and June 1948 the caloric value of a normal consumer rarely exceeded 1,500 calories a day.² As a consequence, in June 1947 only 22% of the city dwellers of the US zone recognized in a poll that the food supply was adequate (while 64% of those living in a small village provided the same answer).³

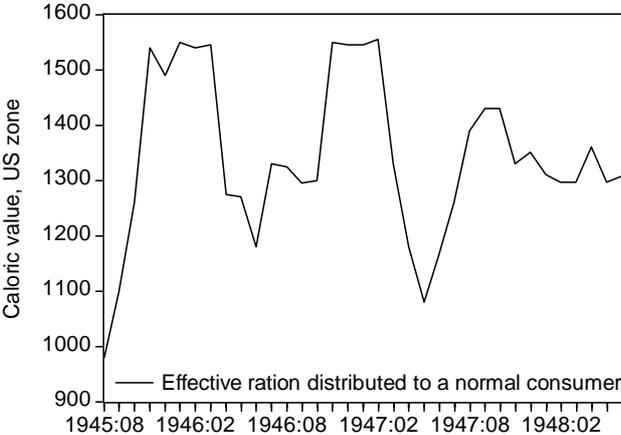


Figure 1: Caloric value of the monthly ration of a normal consumer (US zone)

Source: various issues of the statistical annex of the monthly report of the Military Governor of the US zone)

This lack of calories distributed through the rationing system created roots for the development of illegal exchanges. Various types of black marketing flourished as early as during the summer of 1945. Indeed a note of the US army dated the 30th of July 1945 reported

² The other groups included to heavy workers, pregnant women and various categories for children and teenagers. A typical normal consumer was a white collar working in the service industry.
³ See OMGUS report #363. ICD.

that farmers refused to deliver the food to the rationing system, even when the German officer was accompanied by US soldiers. It was further indicated that this entailed “a noticeable loss of food from the normal market channels” because of “the people from the city going to nearby farms and buying on the spot.”⁴ According to a May 1946 poll of the US occupation authority, 18% of the sample recognized travelling regularly to the countryside in order to complete their food ration.⁵ Illegal markets for foods also emerged in the central places of big cities and near the train station of each town.⁶

The market share of illegal markets had been big for products such as foodstuffs, clothes or shoes. In November 1945, an official report of the US army gauged that the proportion of illegal exchanges of foodstuff amounted to 20 % of all trades⁷ and six months later, it had grown up to 50 % for some goods.⁸ The experts of the US military government believed that between one-third and one-half of business transactions proceeded in the form of barter trade (Menderhauser, 1949, p. 655). Ostrander, the head of the Price Control Section of the US Economic division, gauged in May 1947 that "the amount of food lost to control distribution through such channels is substantial, perhaps 20%" and that "the black market activity have assumed increasing significance during the last year" (Herald Tribune, 05.21.1947).

1.2. The Reichsmark, price controls and inflation

The money stock – currency and deposits – had surged hugely during the war, increasing from 56.4 billions in 1938 to about 300 billions in May 1945 (Hansmeyer and Caesar, 1976, p. 418). In 1945, the money stock amounted to 230% of the 1944 GDP while the stock of

⁴ Report entitled « BM operations in the American occupied zone”(07/30/1945), OMGUS archives, file 1/177 3/8 shelf mark BICO C+J

⁵ Cf. Merritt (1970) "Public Opinion in occupied Germany, The OMGUS Survey", University of Illinois Press.

⁶ See for example the various report of the Bavarian food ministry at the Bayerische Hauptstaatsarchiv (Munich). File MELF 1118.

⁷ Monthly Report of the Military Governor of the US Army in Germany #5, december 1945, section "Trade and Commerce", available at the Institut für Zeitgeschichte, Munich, Germany

⁸ Cf. Monthly Report of the Military Governor #11

currency represented 40% of 1944 GDP. Various measures reduced M3 by about 127 billions and during spring 1947, it was then gauged to 173 billions, including 79 billions of currency.⁹

To avoid the development of a hyperinflation, the Allies decided to continue to work with the system of price control set up by the Nazi regime in 1936 and reinforced during the war. Two main changes however occurred. First there was no central (German) authority responsible for managing the system but rather an Allied Control Authority (ACA) while the (German) regional price offices kept the responsibility to allow most of price increases¹⁰. Second the Allied strictly monitored both the working of the local price offices and of the price polices that were in charge of monitoring the implementation of regulations.

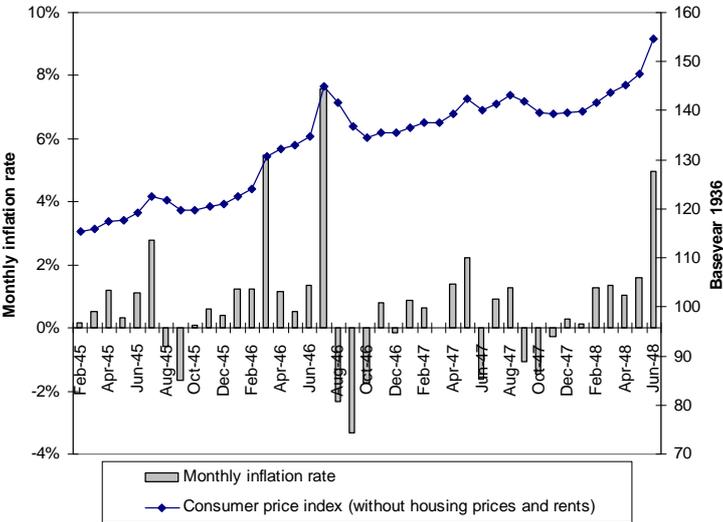


Figure 2: The evolution of the Bavarian Consumer Price Index and of the monthly inflation rate of prices (source: Bayerische Statistisches Landesamt)

On February 6, 1946, the ACA issued a statement that “prices are to be maintained a the level before occupation” and “price increases shall only be permitted as an exception”. Figure 2 shows the evolution of the Bavarian consumer price index. The evolution of this index indicated that the price authorities had been more lax towards prices increases than was

⁹ This includes 73 billions of currency in 1945 (70.3 billions of notes, 1.6 billion of Reichsmarks in divisionary coins and 1.1 billions of Rentenmarks) and 12 billions of banknotes issued by the occupation authorities (Allied Reichsmarks) to which one must subtract 6 billions of banknotes destroyed (Samuelson, 1972, p. 171-2). Petrov (1966) disputed the figures released on Allied Reichsmarks issued and argued that the Soviet had inflated a lot the money stock to destabilize the economy of the Western part of Germany. I did not find any document in the archives that could have corroborated this opinion. Moreover the public budget was balanced as soon as in 1947.

¹⁰ See Menderhauser, 1949, p. 647-8

recommended by the Allied.¹¹ The reason was that exceptions included the possibility to increase prices if firms encountered losses. And actually a 9 years froze must have created a lot of distortions in relative prices. Under the first three years of the Allied rule, from May/June 1945 to June 1948 the CPI increased by 27% while it had increased by only 20% between 1936 and May 1945. The annual inflation rate of official prices can hardly be qualified as a hyperinflation as prices went up by 13%, 4% and 10% during the first years of occupation.¹²

1.3. To black trade, barter or commodity moneys were preferred to fiat money

The low level of calories delivered through the rationing system distracted people from obeying the law and they went on foraging for food in the countryside (Diskant, 1989, p. 555). As noticed in the November 1946 Report of the US Military Governor: “Far more than elsewhere, black markets in Germany are sporadic and erratic, consisting almost wholly of many isolated transactions.”¹³ The black market purchases were paid using various goods.

The renouncement to the use of fiat money shall not come as a surprise. The combination of the huge inflation of the money stock and tight controls of prices should have resulted in a very low value of the Reichsmark in trade. Although the rationing (official) system were still characterized by the use of the fiat money, even the US occupation authority recognized in an April 1947 report of the economic division that “The RM is not yet completely worthless but its value is greatly undermined. Only the fact that the RM retains a certain usefulness in connection with the ration coupon gives it some continuing value.”¹⁴ As a consequence Reichsmarks units traded at a discount on post-war black markets that was gauged at about hundred times the legal prices.¹⁵

¹¹ The price offices could agreed on a variation of prices when the producer presented evidence that the official price did not cover the production cost.

¹² Computations were done from June of year X to June of year X+1.

¹³ Monthly report #17, p. 44. See Bignon (2007) for an account of the various illegal market structure.

¹⁴ OMGUS, Econ division, Trade and commerce branch, 04/23/1947. File 1/ 194-1/6, mark BICO US Cust. Gp

¹⁵ Menderhauser, 1949.

Far from just trading their Reichsmarks at a (huge) discount on the black markets, people renounced using fiat money in illegal trades. Sellers and especially farmers insisted on being paid in kind. An April 1947 report of the economic division of the US army indicated “not only does the German farmer now have each larger reserves [of Reichsmarks] than the urban population, but at the same time ration coupons have less meaning for the farmer than for the city dweller, since the farmer produces his own food.”¹⁶ And consequently US detachments reported that “Workers no longer have faith in currency, and whenever they can receive money in payment for their work, they prefer goods.”¹⁷ The stock of currency held by commercial banks in the US zone therefore raised six fold between December 1944 and March 1948, from less than two billions to more than 12 billions (see figure 3, the estimate of the stock of currency amounts to about 79 billions Reichsmarks for Germany as a whole).

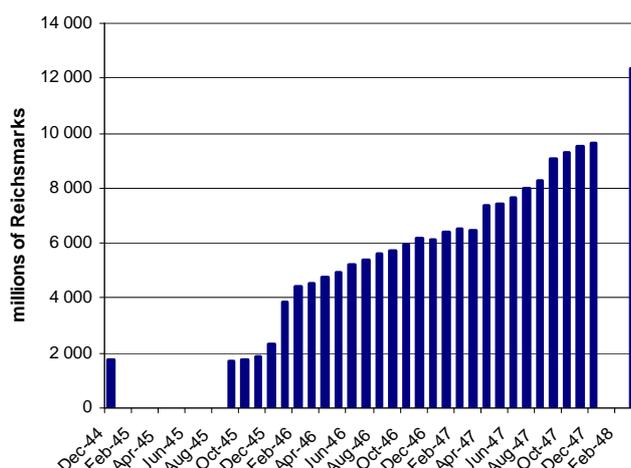


Figure 3: Value of Reichsmarks notes held by banks in the US zone (Dec. 1944 - March 1948).
Sources : Monthly reports of the military governor of the US zone of occupation, various issues.

The return on using fiat money in payments was lower than the return on using goods, even if this implied paying high transaction costs for finding a double coincidence of wants. As a result of the Reichsmark losing its medium of exchanges function, the black market prices were also immune from any inflation, at least from spring 1946 onwards (Menderhauser, 1949, p.

¹⁶ Report dated 04/23/1947. OMGUS, Econ division, Trade and commerce branch APO 742, file 1/ 194-1/6 shelf mark BICO US Cust. Gp.

¹⁷ Periodic report for week ending on the 4 th september of 1946 from Det. 245, Landshut and Det. 348, Stadtsteinach. See National Archives of Bavaria, OMGBY file 10/85 3/1.

654). At least until 1947, this intrigued the US authority which repeatedly reported it in the monthly reports of the military Governor. Figure 4 shows that after an initial surge during the first months of the occupation, there was no positive trend on the black market in Frankfurt.

Most the US reports and the academic articles written by the economists who worked for one of the Western Allies in Germany then pointed that people used “various forms of direct barter” as substitutes “for normal methods of purchases and sales”.¹⁸ Most observers indicated that each good could have been used as means of payment provided a seller accepted it in payment of its holdings. Sauermann qualified the economic life as a “primitive barter economy [that] guaranteed nothing more than an animal life” (1950, p. 178). Menderhauser (1949) pointed the “economic incongruity” of a “system of reciprocal exchanges of goods”.

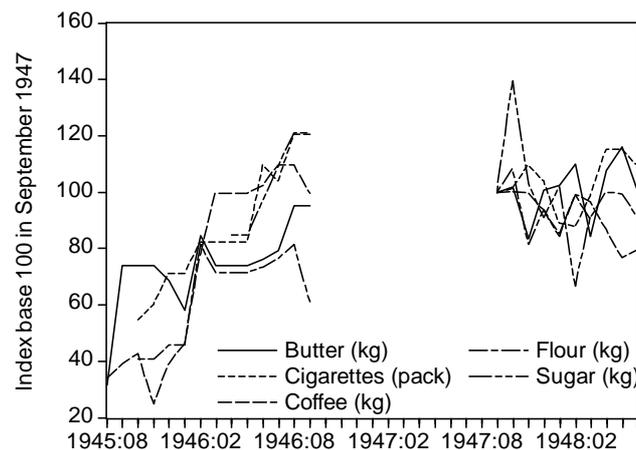


Figure 4: The evolution of black market prices in Frankfurt am Main August 1945-June 1948

Sources: Aug. 1945-Sept. 1946: OMGUS archives file 1/194-1/6 BICO US cust gp; Sept 1947-Jun 1948: Kropat Wolf-Arno, 1979, Hessen in der Stunde Null 1945/1947.

Some among the academics as Friedman (1951, p. 204) noticed that cigarettes, chocolate, candy bars and alcohol were regular means of payment. This does not come as a surprise as the exchange pattern between agents exhibited many transaction costs. Trades were completed in a much disorganized fashion with mostly decentralized trades in pairs and some kind of random

¹⁸ p. 2 of the August-September 1947 issue of the Monthly Report of the Military Governor - US zone. According to Lutz (1949), people “acquired most of the commodities they wanted against commodities they had to offer”.

search.¹⁹ Indeed the typical trading pattern was the following: City dwellers (buyers) travelled to the countryside or any places specialized in the production of the desired good with some valuables, cigarettes or industrial items and searched for a farmer (seller) ready to make a deal.²⁰ Often it took a while to figure out a seller that agrees to trade some food against the particular holding of a seller. Most of the time the seller at the first door at which the buyer knocked in some villages did not find it valuable to trade but if the buyer was fortunate enough, he will have gleaned some advices on whom could have be ready to trade. Another strategy was to carry on goods that were more acceptable by farmers such as commodity moneys.

2. Literature and data

2.1. *What makes money special? Money and the liquidity of the goods.*

That money should have a higher liquidity than any other goods is an idea that dated back at least to Carl Menger (1892) and his idea of comparing the *saleableness* of the commodities. The point that is most relevant to our analysis is that “when the relatively most saleable commodities have become ‘money’, the event has in first place the effect of substantially increasing their originally high saleableness” (p. 250). He further argued that this greater *saleableness* impacted the relative prices, i.e. that the relative prices of commodities in terms of the commodity used as money experienced smaller variations than the relative prices expressed in others commodities.²¹ He also noted that a precondition was “a sufficient supply of [precious metals] had been collected and introduced into commerce” (p. 254).

Recently the search models of money revived the Menger’s intuition that money is the most liquid good (Kiyotaki and Wright, 1989, 1993). The notion of liquidity in those

¹⁹ see Bignon 2007 for a rationale.

²⁰ As mentioned in the Herald Tribune on February 28, 1947 in an article titled "The Cigarette Standard": "A lot of them (cigarettes) undoubtedly end up in the hands of farmers because cigarettes are a way of getting food".

²¹ The exact quote is the following : “This development [of the use of precious metals as money] was materially helped forward by the ratio of exchange between the precious metals and the other commodities undergoing smaller fluctuations, more or less, than that existing between most other goods, - a stability which is due to the peculiar circumstances attending the production ,consumption, and exchange of the precious metals, and is thus connected with the so-called intrinsic grounds determining their exchange value” p. 254

models hinges particularly on the acceptability of the good in the population, i.e. on the proportion of agents in the economy that accepts it in payment. Building on this concept, they show that specialization in productive activities makes agents willing to trade their goods against an intermediary of exchange that become widely accepted by the whole population, i.e. the most liquid good. They further prove that good intrinsic properties do not constitute a necessary condition for a good to be used as money. Later models used alternative specification of the intrinsic property components and showed that, provided the intrinsic component is not too bad, this basic result holds (Renero, 1999, Cuadras Morato, 1997). This indicates that to a certain extent the notion of liquidity (understood as the acceptability of goods by a population) is a substitute to the intrinsic component part of the goods traded.

The liquidity component specific to the good used as money in those models hinges on the fact that when agents came to use an intermediary of exchanges, they created an additional demand for the good used as a medium of exchange (Cuadras Morato and Wright, 1996). This additional demand added to the demand for consumption purposes to make it the most widely acceptable among agents and can even induce some of its consumers to renounce to its consumption. Drawing on the work of Burdett, Trejos and Wright (2001), Bignon (2004) extended the model to analyse how the use of such commodity money can be linked to the proportion of consumers of that good in the population and the utility to consuming it. The results shows that if a sufficiently high proportion of the population accepts one good as a consumption good, then non-smokers will have an incentive to use it as money to reduce the search cost. But for smokers to renounce to the consumption, the utility of the good has to be sufficiently low. If both conditions hold, then a commodity could become money, i.e. the whole population used it to pay for their purchase of other goods.

The key element in those models is the explicit modelling of the reasons that explained the demand for a medium of exchange, i.e. for using a (indirect) trade strategy alternative to a

direct barter²². In the Kiyotaki and Wright (1989, 1993) models, specialization in productive activity reduced the return of direct barter by making it less likely to succeed on the market place. This results hinges then on modelling some degree of absence of double coincidence of wants. Therefore agents become willing to substitute their holding against a medium of exchanges, i.e. a good that has a greater acceptability in the trade process. The literature shows that other frictions impeding direct barter can be incorporate in the decentralized search framework to account for the demand for money as a medium of exchange (see Shi 2006 for a survey). This included imperfect information on the quality of the goods produced (Williamson and Wright, 1994), inefficiency in the bargaining process (Engineer and Shi 2001, Berentsen and Rocheteau, 2002), or in a dated goods economy some friction that impede the use of alternative payment arrangements such as IOU when there is a limited commitment to repay the debt through direct barter (Kiyotaki and Moore, 2004).

This highlighted that the equilibrium liquidity of the good(s) used as money must be greater than the liquidity of all the other goods. Following the literature review, two measures can be used to proxy the liquidity of the goods. First a measure of price dispersion to account for differences in the relative prices and second an indicator of the coverage of the selling of the good, of the easiness with which people could have sold/buy their commodity.

2.2. The sample of black market prices

This paper uses black market prices in 120 out of 143 Bavarian districts. These prices are available at the county (*Landkreis*) level for two dates, July 1st, 1947 and June 30th, 1948. All prices are denominated in Reichsmark in 1947 and in Deutsche Mark in 1948. The greatest distance between two districts is 488 kilometres while the smallest is 8.5. Prices were collected in September, 1948 by the Economics division of the U.S. occupation army of Bavaria

²² Another important feature of those models is to insist on the difficulty to use alternative payments scheme to monetary exchange. This includes gift giving economy (Kocherlakota, 1999), i.e. economy in which a record keeping device is set to keep track of the completion of trades, or repayment of credit arrangement through credit. We do not discuss this dimension in this paper since the very nature of black market trade makes those alternatives very costly.

(OMGB) that asked their correspondent to give the representative black market prices at the beginning and the end of the period covered by the survey (available at the Bavarian archives). The questionnaire and the answers are in English. The sources used by each local office could have been the soldiers (who were very active on those) or the (German) local price police which monitored those markets. Both knew very well the phenomena.



Map 1: Post WW II Germany, the *Länder* and the occupied zones

The survey gave the prices of eight goods: butter, sugar, coffee, cigarettes, meat, flour, U.S. Dollar and Military Payment Coupon. The Military Payment Coupons (thereafter MPC) were labelled in dollar and their original usage was for soldiers to pay in military shops. All prices are for 1 kg except cigarettes (one pack), dollar and MPC.

On these eight goods, three were produced locally: butter, flour and meat. A statistical survey of the Bavarian statistical office helps to have a better idea of the specialization of the agricultural specialization of Bavaria.²³ The main cultivation was wheat which represented 52% of the cultivated surface in the sample of counties studied. The area devoted to sugar amounted to 13,705 acres and represented 0.78% of the agricultural surface. sugar was then mainly imported from outside Bavaria. This was of course also the case for MPC and US dollar that were supplied mostly through US soldier. The remaining goods were imported and for example coffee was typically a “colonial” ware.

Two types of cigarettes were traded on the black markets, either those made with dark tobacco or those of the Virginia type. As a result it was easy for traders to recognize the quality of those cigarettes. Botting (1985) noticed moreover that intermediaries helped to deal on the black market with the quality and weight of the cigarettes traded. The German production consisted of dark tobacco that was grown in two regions close to Bavaria (Schwaben for 50% and Pfalz for 30%, cf. Ruland, 1968, p. 58-59). This production amounted to 30 thousands tons a year. It was used to distribute cigarettes to consumers as part of their ration.²⁴ On the black market, German cigarettes traded at a 20% discount on U.S. cigarettes.

American cigarettes entered the German economy by smuggling with neighbouring countries or through diversion of the import of the US army to supply the messes. Illicit imports by traffickers came from Czechoslovakia, Hungary, Belgium and the Netherlands or

²³ The book was edited as part of a series of publication “Beitraege zur Statistik Bayern” and is entitled *Bodennutzung und Ernteergebnisse 1946 und 1947* (number 143).

²⁴ The ration of cigarettes was forty a month (valued around two-third of the monthly wage of a secretary in Berlin, cf. *Herald Tribune* – May 21, 1947 edition).

through the Hamburger haven (see Hess, 1996). Those traffickers also took advantage of the legal import of cigarettes by the US army to divert part of the delivery. For example, the newspaper *Frankfurter Rundschau* indicated that 10% of the 210 million American cigarettes had stored in a Frankfurter warehouse in October 1947 had disappeared by April 1948.²⁵

But the prominent suppliers of American cigarettes were the US soldiers. They bought cigarettes either directly at the messes or ordered them to US based firms through their family and friends. The US military government for Germany²⁶ gauged these imports during spring 1947 by checking the content of some of the 200 000 packages sent to soldiers between March and June. According to the newspaper *Rhein Neckar Zeitung*, they found cigarettes in 95% of the checked parcels.²⁷ Hess (1996) provided a lower estimate with " half of the 3 million packages which arrived every month by military mail from the US were cigarette shipments".

3. Cigarette money in post WW II Germany

Contrary to what we are accustomed to with modern monetary economy, the use of cigarettes as money did not rule out the use of barter or other commodity money. But many qualitative evidences of the particular role of cigarettes can be provided (3.1.) and the study of the liquidity of the sample of black market goods in Bavaria confirmed this (3.2 and 3.3).

3.1. Historical evidences emphasizing the unique role of cigarettes in payments

The insistence of most US reports and some other works pointing that Germans bartered a lot on the black markets is at odds with many other evidences that insisted on the use of cigarette as money and on the emergence of commodity moneys to reduce the transaction cost associated with a barter economy. Clearly the kind of situation in which city dwellers travelled to the countryside and searched for a suitable trader was characterized by huge transaction costs. Although some countrymen undoubtedly gave information to buyers on potential sellers

²⁵ cited in *Frankfurter Rundschau* April 21, 1948

²⁶ Cited in the *New York Herald Tribune*, 05/17/1947.

²⁷ Cited in the newspaper "*Rhein Neckar Zeitung*" # 87 of the 29th of July, 1947

and then reduced the search cost, using a commodity money was another strategy to reduce it. Hence although some farmers did help city dwellers to direct their search towards the agents with whom they could have a double coincidence of wants, Germans also carried on holdings to reduce the search cost just as the search models of money predicted. Moreover the unlawful nature of those trades made credit difficult (Thurnwald, 1948).

Most of the evidence on the special character of cigarettes comes from newspapers articles or German post war scholars. Many authors noticed the peculiar role played by cigarettes in the illegal sector. To cite just a few references, Hess (1996) and Bub (2004) provide detailed studies of its use as money. They indicate that cigarettes had a universal acceptability in post WW II Germany: everybody accepted them in payment. Moreover the acceptability of cigarettes on illegal markets were far higher than the one of the Reichsmark as highlighted by the Herald Tribune in its issue of the 28th of February, 1947, “Anything money will buy, and a good many things it won’t, can be had for cigarettes in Germany today”. And in December 1945, the newspaper Stars and Stripes noticed their “exorbitant prices” and explained it by the fact that “cigarettes buy potatoes, meat and other necessities because in this fantastic city-market [Reichs]marks are considered hardly worth more than the paper they’re printed on”²⁸.

The evidence pointed to the monetary function of cigarettes as a medium of exchanges and unit of account. In an article published during May 1947, the Herald Tribune wrote that “all prices in this shadowy world of commerce are either based or quoted in terms of American cigarettes (...) when shopping around for items, a visitor to “Black market alley” [in Franckfurt] will find dealers constantly quoting prices in *Stangen* (cartons). “*Eine Stange*” for this; “*Zwei Stangen*” for that”. (05.17.1947). About two weeks later, it wrote that “cigarettes today are too expensive for the average German to smoke but they provide a portable, easily

²⁸ In Stars and Stripes, 12/30/1945, “Big Business: New York Fifth Avenue is a Bargain Deal Compared to Berlin’s Lush Black Market”, by Jack Caldwell.

negotiable medium of exchange” (05.21.1947). And Botting (1985, p. 179) gauged that cigarette changed “hand a hundred times before reaching the end of the line, the smoker”.

The following quote sums up the relative advantage of cigarettes over other goods:

In Germany, cigarettes lubricate the trade. For instance, if a Berliner has a large radio that he has decided to sell, he cannot conveniently lug it out into the country in search of a farmer willing to give him butter for it. Instead, he trades it to a black marketer for cigarettes and takes the cigarettes to the farmer. This has had advantage that he can dispose of the cigarettes bit by bit instead of having to accept a whole radio's worth of butter at one time. Meanwhile, the black marketeer takes the radio to an American officer who gives him more cigarettes. With these he can get another radio or butter or whatever he needs to carry on his trade. Then he can sit down and smoke his profit — or a part of it.

Herald Tribune, The Cigarette Standard, February 28, 1947

The use of cigarettes as money was so widespread that the US army promulgated on the 26th of May, 1947 a new regulation that prohibited the free import of cigarettes by U.S. soldiers.²⁹ The ban applied to the “mailing or shipment of these commodities through army post offices, international mail or commercial channels” and the war department coupled its action with an appeal to the general public for co-operation “in a strong move to wipe out black market trading in American cigarettes and tobacco”³⁰. The newspaper Tagespiegel however indicated that the main consequence of this new regulation was not to inhibit the use of cigarettes as money but rather their prices (4 August 1947).³¹ Nonetheless the interesting consequence for the researcher is that the preparation of this regulation led the US occupation authority to mention for the first time in the Monthly Report of the Military Governor the monetary character of cigarettes as it stated in February – March 1947 that “to an increasing degree the Reichsmark prices of good have become subsidiary or have even been eliminated entirely from transactions in favour of a variety of direct barter ratios between goods, especially between cigarettes and other goods”.³²

²⁹ Cf. Die Wirtschaftsspiegel, July 15, 1947, „Zigaretten, die Vermögen liquidierten“

³⁰ The Herald Tribune, 05/21/1947, “German Food Crisis Is Laid To Black Market and Cigarette” by John Elliott

³¹ The original quote is: "Die „Zigarettenwährung“ ist nicht abgeschafft, sie ist nur aufgewertet worden, und weitem die gestiegenen Zigarettenpreise haben alle anderen Schwarzmarktpreise mitgezogen“. Nicht allein der Kaffee auch die Butter ist teurer geworden, der Zuckern die Feuersteine, viele Dinge, die ihrer Herkunft nach nicht ausländischen Quellen entstammen, sich jedoch offensichtlich nach der Zigarettenlage orientieren“.

³² OMGUS #21, February and March 1947, section Price control, p. 19. The Herald Tribune copied this sentence in its May 21, 1947 issue.

Finally as another evidence of the value of cigarettes and of the huge disequilibrium between the supply and the demand (estimated to 80,000 tons by the newspaper Die Welt), a new type of entrepreneur emerged. Some clever people established small factories of cigarettes and bought the raw material from the *Kippensamler* – literally the collectors of butt-ends – who collected them from waiters and maids at places where cigarettes were thrown in abundance such as cinema, entrance to messes, soldiers’ clubs (Botting, 1985, p. 179).³³

3.2. Comparing the liquidity of cigarettes to the other goods

Two criteria are used to measure liquidity: 1) a coverage ratio measuring the probability that a given good is sold on those black markets and 2) the coefficient of variation of prices across locations. The first criteria indicated that cigarettes, like butter or coffee, benefited from a wide coverage while U.S. dollars and MPC – the two fiat objects– were quoted in only half of the counties. The coefficient of variation of relative prices measures the risk of using one good or another to pay for those trades. This measure is especially accurate when agents arbitrated between districts with goods rather than *Reichsmarks*.

The notable feature is that this statistics is always lower when the relative prices are computed in cigarettes, even when compared with fiat objects of perfect homogenous quality. This means that using cigarettes to trade in another district made people suffering from a lower spatial variation of prices than when holding another good. This suggests that the best strategy when using indirect barter was to pay with cigarettes.

July 1, 1947	Butter 1947	Coffee 1947	Sugar 1947	Cigarettes 1947	Meat 1947	Flour 1947	M.P.C. 1947	U.S.D. 1947
Mean of prices	281,94	585,12	142,35	104,54	71,46	30,16	167,32	242,23
Max	500	1300	400	260	360	120	400	600
Min	70	80	22,5	60	12	5	45	40
Range (= max/min)	7,14	16,25	17,77	4,33	30	24	8,89	15
# of observations	120	119	119	120	116	110	71	66
Cover ratio ³⁴	100 %	99,17 %	99,17 %	100 %	96,67 %	91,67 %	59,17 %	55 %

³³ It was estimated that the waiters of the Café Wein in Berlin earned an average of 50 Reichsmarks or 5 \$ per day for selling 75 to 100 butts to a “Kippensamler”. Using the fact that Botting indicated that it took 7 butts to manufacture a new cigarette, the 100 butts collected for the Café Wein allow to make about 15 new cigarettes.

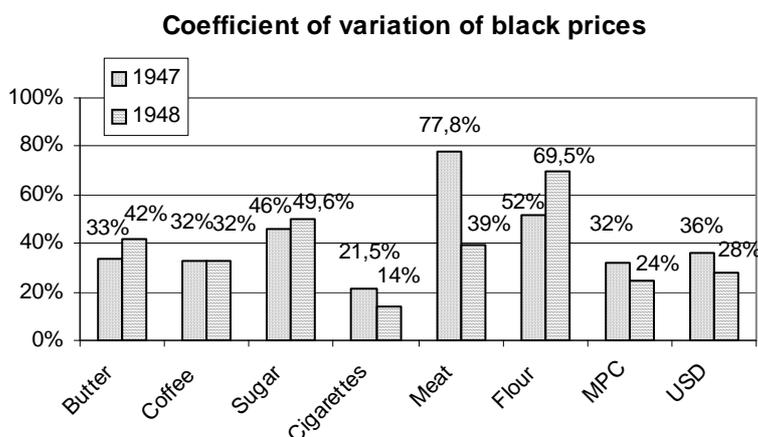
³⁴ Is equal to the ration of the number of observations by 120 the maximum number of counties of the sample.

June 30, 1948	Butter 1948	Coffee 1948	Sugar 1948	Cigarettes 1948	Meat 1948	Flour 1948	M.P.C. 1948	U.S.D. 1948
Mean of prices	11,66	24,96	4,57	4,68	5,08	1,43	9,91	13,99
Max	32	50	10	7	12	6	15,5	30
Min	2,5	5	1	2,5	1,75	0,3	4,5	7,5
Range (= max/min)	12,8	10	10	2,8	6,85	20	3,44	4
# of observations	116	115	76	117	103	96	78	72
Cover ratio	96,67 %	95,83 %	63,33 %	97,50 %	85,83 %	80 %	65 %	60 %

Table 1: Descriptive statistics of the sample of Bavarian black market prices

Table 1 gives the descriptive statistics for every good. The first line gives the mean of prices. The huge variation displayed between 1947 and 1948 is explained by the monetary reform of June 20, 1948 which was characterized by an exchange of the Reichsmarks against Deutsche Marks at the ratio of 20 to 1. Apart from this drop in the mean of prices, the cheapest item in 1947 and in 1948 was flour while coffee was the most expensive.

The cover ratio measures the number of counties in which there were a price quote for a good. It is a proxy to measure the liquidity as long as agents arbitrated among counties and mainly used barter (rather than fiat money). In that situation, they had to take into account the probability of selling their holding when arriving in a county. In 1947, butter, cigarettes, coffee and sugar were sold in (quite) all districts while dollar and MPC were sold only in 55 % and 59 % of the districts. In 1948 as compared to 1947, the liquidity of sugar, meat and flour decreased by respectively 30 and 10 points while other goods remained quite stable.



Graph 5: The coefficient of variation in 1947 and 1948

Price dispersion was very high for all goods, either for those produced locally or "imported". This is not surprising as long as one remembers the trade pattern on illegal markets described in section 1. While various alternative measures of price dispersion have been applied in the literature, two are especially accurate, the coefficient of variation and the range. The range is computed as the ratio of the highest over the lowest price. As such, it is scale independent but is not independent of the size of the sample. On the contrary the coefficient of variation – defined as the standard deviation divided by the mean – has the advantage of being both scale independent and unaffected by changes in the number of observations.

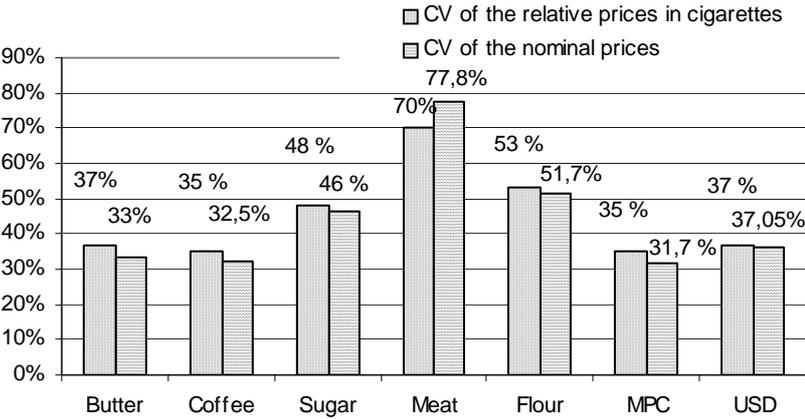
The range of prices is large for any good with a minimum value of 4 for cigarettes in 1947 and for MPC and dollars in 1948 (table 1). But the highest price of butter in 1947 was 7 times bigger than the lowest price and for sugar and coffee it was more than 16 times bigger. This is indicative of huge spatial difference but as those results could have been driven by some outliers, it is worth to turn to the analysis of the coefficient of variation (CV). The coefficient of variation is very high both in 1947 and 1948 (graph 5). The cigarettes' pack had the lowest coefficient of variation both in 1947 and 1948 with respectively 21.5% and 14%. Apart from cigarettes, the coefficient of variation varied in 1947 around 30 % for butter, coffee, M.P.C. and US dollars and increased to 46% for sugar and more than 77 % for meat. Those figures changed sharply in 1948 except for meat characterized by a big drop at 39 % and flour that increased from 52 % in 1947 to about 70 % in 1948.

Coefficient of variation of relative prices (RP) in 1947	RP in cigarettes	RP in butter	RP in coffee	RP in sugar	RP in meat	RP in flour	RP in M.P.C.	RP in dollar
CV of cigarettes	0	0.56	0.59	0.67	0.78	0.68	0.40	0.85
CV of butter	0.37	0	0.53	0.65	0.63	0.70	0.54	1.04
CV of coffee	0.35	0.46	0	0.58	0.78	0.63	0.45	0.52
CV of sugar	0.48	0.55	0.74	0	0.84	0.61	0.58	0.85
CV of meat	0.7	0.8	0.68	1.56	0	0.74	0.82	0.92
CV of flour	0.53	0.64	0.72	0.67	0.70	0	0.77	0.76
CV of M.P.C.	0.35	0.51	0.54	0.95	0.71	0.68	0	0.25
CV of dollar	0.37	0.56	0.51	0.83	0.62	0.65	0.29	0

Table 2: The coefficient of variation (in line) of relative prices

As mentioned in the first section, most trades were done either through barter or cigarette money. Computing the coefficient of variation of relative prices is then a more accurate measure of price dispersion. Table 2 presents the coefficients of variation of these barter ratios. They were computed by dividing the price of each item in one district by the price of the benchmark good in the same district. Two remarks are in order.

On one hand, the coefficient of variation for relative price gives a measure of the risk associated with the use of barter or cigarettes money. This measure is especially accurate if agents arbitrated between districts with goods rather than Reichsmark. The notable feature of table 2 is that the coefficients of variations are always lower when the relative prices are computed in cigarettes. For example the coefficient of variation of butter (line 3) shows that its prices were less dispersed when the benchmark good is cigarettes (0.37 or 37 %) while it increased to 0.53 for coffee and to 1.04 for dollars. Doing the same exercise for the other goods (lines) shows that the coefficients of variation are the lowest for cigarettes (column 1). This means that an agent who took cigarettes to trade in another county suffered from the lowest possible spatial variation of prices (provided the district was randomly chosen). This suggests that to complete indirect barter, the best strategy was to use cigarettes in payments.



Graph 6: Comparison of the coefficient of variation of the relative prices in cigarettes and nominal prices

On the other hand, the coefficient of variation of the relative prices in cigarettes did not differed sharply from those computed with nominal prices (graph 6). This indicated that

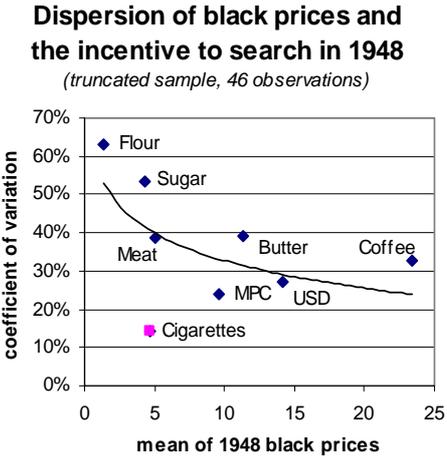
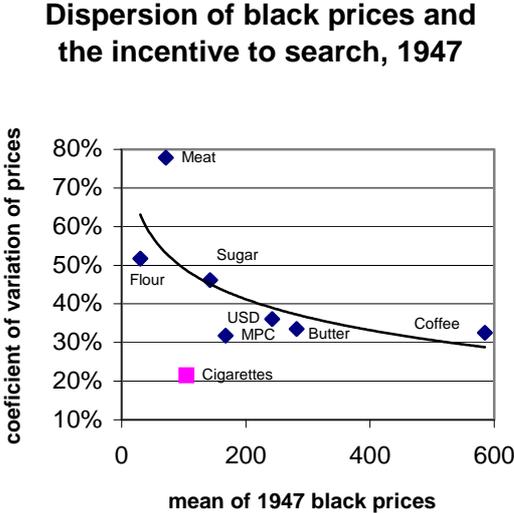
cigarettes did not lower price dispersion as compared to Reichsmark. One possible explanation for this low variation is as follows: Agents usually pay their purchases with cigarettes and then it could be that most of the observed quotes that local price office were in cigarettes' pack. But as the survey asked them to give the price quote in fiat money, at least some offices converted the relative price in cigarettes by using the exchange rate between Reichsmark and cigarettes.

3.3. The incentives to search and the one exception, cigarettes

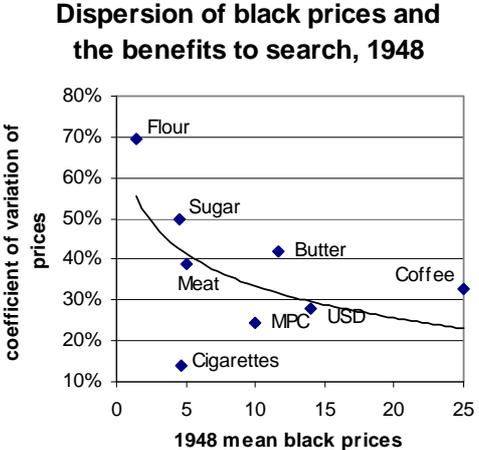
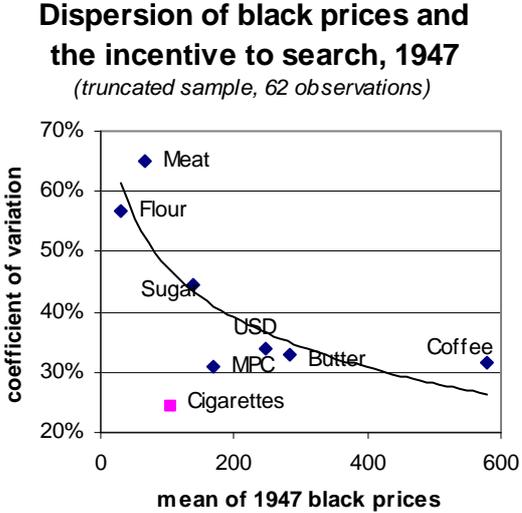
In this section, I use the insights of consumer search theory to check whether it can rationalize the patterns of price dispersion exhibited in the sample. The consumer search theory was first introduced by the seminal paper of Stigler (1961) that explained the dispersion of prices by relaxing the assumption that agents know precisely the locations where the cheapest prices are quoted. To arbitrage, agents must then search sequentially for the best price among the whole distribution of prices and the key assumption is that this search is costly because agents incur a positive cost of obtaining each additional price quote. The key result of these models lies in the fact that consumers stop searching before they obtained the cheapest prices. In a model with identical buyers and in which sellers posted prices, Diamond (1971) showed that the price set by sellers is the monopoly prices. However, as long as consumers are heterogeneous, the equilibrium price distribution is non degenerate and typically there is some price dispersion in equilibrium (Baye et al., 2006 for a survey).

Given the description of illegal exchanges in post World War II Germany, it seems natural to use this theory to investigate the properties of our sample. One of the most prominent results of this theory is that there exist a link between the price dispersion and the value of the good. This results from the fact that consumer will have an incentive to search longer for the lowest price when the item is more costly to purchase. Following Stigler (1961), there must then exist in equilibrium a negative relationship between the (mean) price of one good and the observed coefficient of variation. Using historical data on the prices of 4 goods in 1901 in more than

hundred cities, Eckard (2004) also exhibited this inverse relationship between price dispersion and the (mean) price of the product (p. 105). Pratt, Wise and Zeckhauser (1979) observe a similar pattern in a cross-section of consumer products sold in Boston in the 1970's and find a significant relationship between standard deviation of prices and the mean price.



Graph 7: Coefficient of variation and the mean of 1947 black prices



Graph 8: Coefficient of variation and the mean of 1948 black prices

Graph 7 and 8 plot the relationship between the mean prices of each of the 8 goods and their coefficients of variation in 1947 and 1948. They indicated an inverse relationship with the cheapest items (flour and meat) having the greater dispersion while the most expensive (butter and coffee) have a lower dispersion. They also show that cigarettes were an outlier as they were the third cheapest items but had the lowest coefficient of variation. To check the robustness of

this result, I plot the same graph using a truncated sample (right plots). It was constructed by selecting only counties in which all goods were sold. They show no significant changes.

As expected, graph 7 and 8 exhibited a negative relationship between the incentive to search for the lowest prices and the price of the good. But cigarettes were an outlier as their (observed) coefficient of variation is lower than what their market value would have implied. This is especially striking since part of the coefficient of variation must have been driven by heterogeneity in quality. Despite this potential problem in the measure of the cigarettes prices, their coefficient of variation is still lower than the one of perfect homogenous goods such as the Military Payment Coupon or the U.S. dollar.

4. Side issues: Ruling out the case of segmented black markets.

The level of price dispersion indicated that the law of one price (LOP) did hardly hold on those markets. Besides consumer search incentives, two other candidate explanations could have account for high coefficient of variation. First it could have been that the LOP hold in each (separate) region but that interregional differences explained the level of price dispersion. The first subsection tests for that possibility. The second explanation relies on a segmentation of local markets with prices reflecting the local supply and demand. To rule out the possibility, the last subsection correlated the prices with the characteristics of each district.

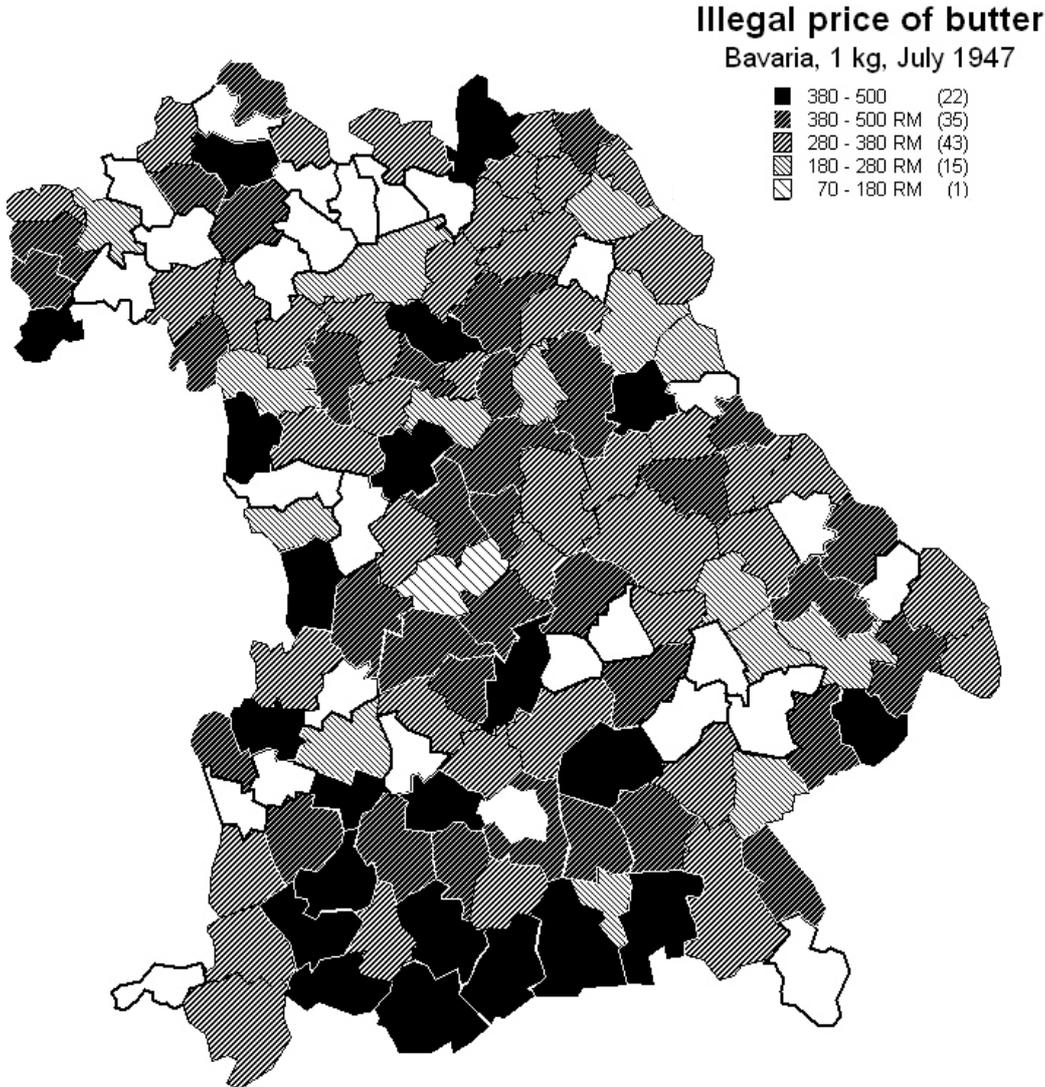
4.1. The case of regional market segmentation

In this subsection, I examine the spatial dimension of the sample to explore whether the level of price dispersion computed with the coefficient of variation can be explained by some regional clustering of the prices. One such possibility could have been that some regions were more expansive than others in say butter. Provided that the differences in prices among Bavarian region were big enough, this could have explained the level of price dispersion.

This section explores the pattern of the spatial distribution of the sample of prices. To get a first insight of this pattern, map 2 provided the spatial distribution of the price of butter (Other

maps are in appendix 4 and 5). Inspection of these maps seems to indicate few spatial clustering of prices, with many adjacent districts characterized by huge discrepancy in prices.

To systematize the exploration of spatial clustering of prices, this section computes a measure of spatial autocorrelation. Measures of spatial autocorrelation are especially interesting to investigate whether prices in one district was similar to the prices of its adjacent (neighbour) districts. Among the most widely used measures are Moran's I statistics (Moran, 1950) that provide evidence on the whole sample and local measures of spatial autocorrelation which give a spatial association coefficient for a particular locality i (Anselin, 1995).³⁵



Map 2: Price distribution of butter in Bavaria on July 1, 1947

³⁵ See for example Shiue and Keller (2004) and Keller and Shiue (2007)

Moran's statistics measures the covariance of prices in connecting districts relative to the variance of the price across districts. Moran's I will be different from zero if prices in connected districts are relatively similar. More precisely there will be positive spatial correlation (with a value of I close to one) if prices are similar among neighbouring districts while a negative spatial correlation will mean dissimilar prices. Table 3 gives the value of the Moran's I statistics for each good either in nominal prices or in relative prices in cigarettes. It shows that no good was spatially correlated with value ranging from -0.1 to 0.1 .

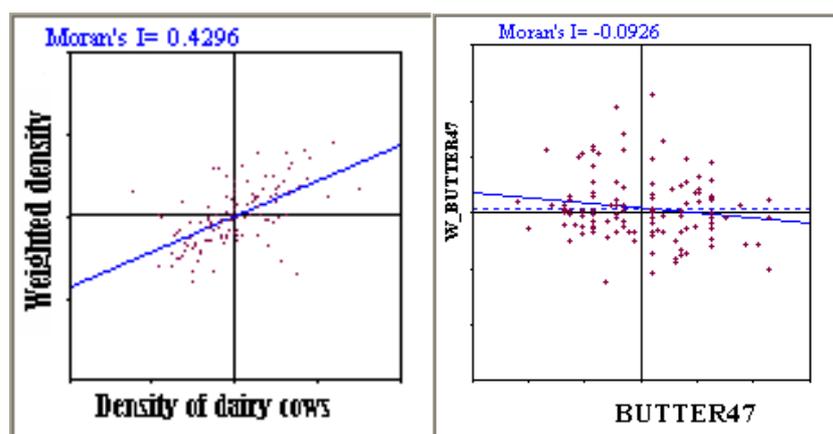
Moran's I statistic	Butter	Coffee	Sugar	Cigarette	Meat	Flour	MPC	USD
For nominal prices in 1947	-0,0926	-0,0227	0,1156	0,0311	0,0255	0,0615	0,0635	0,0036
For RP in cigarettes in 1947	0.0184	0.0906	0.1284	-	0.0166	0.0855	/	/
For nominal prices in 1948	- 0.0305	0.0437	-0.0952	0.0871	0.0794	0.1009	0.1184	0.1557
For RP in cigarettes in 1948	0.1028	0.0907	-0.0582	/	0.206	0.0764	0.1591	0.1723

Table 3: Moran's I statistic for nominal and relative prices in 1947 and 1948

The absence of spatial correlation is striking and need some qualification. A statistical test was then run to decide whether these spatial patterns deviate significantly from a random pattern. Table 4 in the appendix indicates that quite all of the goods of the sample exhibit no spatial autocorrelation at the significance level of 5 % except in 1948 for meat, dollars and M.P.C. for which there is a positive association, i.e. expansive counties tend to be located near other expansive counties.

Figure 7 gives a graphical representation of Moran's I for two examples, the density of dairy cows and the price of butter in 1947. The former is spatially correlated while the latter is not. The I statistics is equal to the slope of the regression line of the scatter plot and is indicated on the top of the graph. The horizontal axis represents the actual value of the variable while the vertical axis plots this value weighted by the value of its neighbours (see the appendix for the weighting method). As a result, the four quadrants in the graph provide a classification of four types of spatial autocorrelation: *high-high* (upper right), *low-low* (lower left), for positive

spatial autocorrelation; *high-low* (lower right) and *low-high* (upper left), for negative spatial autocorrelation. The variables are standardized so that the units correspond to standard deviations. The inspection of the graph shows that districts with a small density of dairy cows tends to have neighbours with a small density of dairy cows (and vice versa) while the graph for the prices of butter indicated that no such relation exists.



Graph 7: Moran's scatter plots of the density of dairy cows and the 1947 prices of butter

This investigation of the pattern of the price dispersion on Bavarian black market indicates no spatial autocorrelation.³⁶ This shows that there were no regions in which the prices of a good tend to be higher than those of another region. The heterogeneity in prices was then not ordered according to a spatial pattern. One possible explanation is that markets were segmented and so that prices differed only according to the local supply or demand. The next subsection tests for this possibility.

4.2. Perfect segmentation of markets?

As noticed above, the dispersion of prices as measured by the coefficient of variation is big for each good of the sample. Moreover, Moran's I statistics and the maps of appendix 3 indicate that the prices varied importantly even between contiguous markets. One explanation of such a pattern is that markets were segmented. This section explain the distribution of black

³⁶ Maps in appendix 3 and 4 show the geography of the prices of *butter*, *meat*, *dollar* and *sugar*. Inspection of these maps indicated that the prices differences do not seem to be spatially positively correlated, as two contiguous districts are often characterized by a huge difference in the expensiveness of goods.

market prices according to the districts' characteristics in order to check whether each district's price was correlated with proxies of the local demand and supply for that good.

The following example explains the intuition. If markets were integrated, the demand on a local black market could have been composed of two elements, the demand expressed by the local agents and the demand coming from agents that travelled to the district:

$$D_{\text{district}} = D_{\text{local}} + D_{\text{travellers}}$$

On the contrary, if agents did not choose to arbitrage, then D_{district} must be equal to D_{local} . Also, on the supply side, the supply in a given district could come either from local or travelling producers. If producers did not choose to arbitrage, then the supply on a local black market is also equal to the supply of local producers. In the case of segmented markets, $p_{ij}(D_j) = p_{ij}(S_j)$ – where i is an indicator of the good traded and j indicates the district – prices must be positively correlated with the local demand and negatively with the local supply.

As neither the quantities sold on each local black market nor each district's production is known, these variables are proxy using indicators of production capacity of the area considered. If markets were segmented, I expect the local supply to be negatively correlated with the price of butter. The demand side is approximated by two sets of indicators: population density as an indicator of urbanization and the mean industrial wages as indicator on the structure of the potential black market demand. The intuition for this is the following. People working in industry had to exchange on the black market in order to get the goods they need. Hence, if black markets were segmented, the more urbanized a district was, the higher the black market price must have been. We also expect that market segmentation would have entailed a positive correlation between the mean industrial wage of the district and prices.

The data needed to construct these variables were collected in the 1947 statistical book edited by the Bavarian Statistical Office³⁷. It gives the surface of each district, the population,

³⁷ In Bavaria, there are two kinds of administrative districts: *Landkreise* and *Stadtkreise* (also named "free cities"). When a *Stadtkreise* was included into the border of a *Landkreis*, I merged the two numbers.

the mean industrial wage of the district, the livestock, the agricultural surface and the working population. The following type of OLS regression tests for the market integration:

$$P_{ij}(1947) = \alpha + \beta * \text{supply} + \chi * \text{Demand} + u_i$$

As for butter, this equation explains the prices of butter in 1947 by a proxy of the local production capacity of butter (the density of dairy cows in 1947) together with a proxy of the intensity of the demand for this good (the mean of industrial wages in the county and the population density). For sugar and flour, the proxy for the supply side variable is the percentage of the cultivated area devoted to sugar and wheat. As for meat, I approximate the local production by the density of pigs in the county. If markets were segmented, we expect the sign of supply side variables to be negative and those of the demand side positive. Results are reported in tables 6 and 7. They indicated few relationships between the local variables and the prices and when one is significant, the adjusted R square is close to 0.

<i>Nominal prices, July 1947</i>	Butter	Coffee	Sugar	Cigarettes	Meat	Flour	MPC	Dollar
Population density	-0,072	0,136	0,0294	-0,013	-0,0011	0,0145	-0,026	-0,114
Mean wage	0,418	-1,105	0,093	0,189**	-0,106	-0,0187	0,366	1,416
Supply side variable	0,295		-0,012		0,431	-69,82*		
Constant	224,1	719,04	124,64	79,46	76,32	39,71	50,91	-47,69
Jarque Berra test	no	yes	yes	yes	yes	yes	yes	yes
Adjusted R ²	0,00%	0,00%	0,00%	1,90%	0,00%	7,16%	1,60%	9,15%
# of observations	116	116	116	116	116	110	71	66

Table 4: Regression results³⁸ for nominal prices in 1947

<i>Nominal prices, June 1948</i>	Butter	Coffee	Sugar	Cigarettes	Meat	Flour
Population density	0,0004	0,005	-0,0017	-0,00016	0,0012	0,0002
Mean wage	0,0331	-0,041	0,022**	0,007***	0,042***	-0,00046
Supply side variable	0,064		0,0001		0,007	0,722
Constant	0,768	29,15	-0,046	3,53	2,38	1,05
Jarque Berra test	yes	yes	yes	yes	no	yes
Adjusted R ²	0 %	0 %	0,47%	1,20%	0,90%	0 %
# of observations	116	115	76	116	103	96

Table 5: Regression results for nominal prices in 1948

Tables in appendix 1 show that using relative prices in cigarettes as the left-hand side variable did not change the results. It then seems that there were no relation between the local

³⁸ *: significant at 1%; **: significant at 5 %; *** : significant at 10 %

demand or supply and the level of prices. One explanation was that prices were not spatial autocorrelated while the proxy of demand and supply were (see table 1 in appendix 1).

5. Conclusion

The German economy experienced a huge change in means of payments with the end of the World War II. The Reichsmark was replaced as the money of the black markets by a combination of barter and commodity money such as cigarettes. This paper uses a new dataset of black market prices to provide evidences that the liquidity of cigarettes was far higher than the liquidity of any other good of the sample. To my knowledge this is the first empirical proof of the old intuition of money being the commodity with the greatest liquidity. The result hinges on the computation of various measures of liquidity such as probability to sell a good in a given district or a measure of price dispersion across districts. To check whether price dispersion was indeed a measure of liquidity, I also show that local black markets were not segmented, i.e. that despite huge spatial variation of prices, they must be consider as a network of interconnected markets. Because all districts quoted cigarettes and because the coefficient of variation of black prices was lower for cigarettes, this indicated that traders were strictly better-off when paying their purchases with cigarettes than with another commodity as they thereby limit the risk of losing because of price dispersion.

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Appendix 1

Relative prices in 1947.

Table 6 indicates the relative prices of each good in the sample in terms of the other goods. It was computed by dividing the average of the ratio of the market price for good j in market i by the market price of benchmark good in market i . We interpret the result as follows: the figures in table 6 are the expected quantity of good that a consumer had to carry to barter it against 1 kg of good i (in line). This interpretation assumes implicitly that this type of action did not change the observation.

This exercise shows that with one kilogram of butter a buyer could have purchase about half a kilo of coffee, two and a half kg of sugar or about 12 kg of flour. Conversely with one kg of flour an agent would have bought only 120 grams of butter, 60 grams of coffee and 30% of a cigarettes' pack. Clearly the prices of flour at that date were so cheap that people really have to carry a huge quantity of it to buy the other goods on the market. On the other side using cigarettes, butter or coffee to pay for purchases needed to carry on fewer amounts of goods and so make it easier to arbitrage between the various markets.

Relative prices (RP)	in butter	in coffee	in sugar	in cigarettes' pack	in meat	in flour	in M.P.C.	in dollar
RP of butter (1 kg)	1,00	0,53	2,41	2,79	5,67	11,80	1,90	1,45
RP of coffee (1 kg)	2,27	1,00	4,84	5,78	12,05	23,75	3,85	2,60
RP of sugar (1 kg)	0,55	0,27	1,00	1,40	2,84	5,55	0,96	0,67
RP of cigarettes (1 pack)	0,43	0,21	0,93	1,00	2,27	4,45	0,69	0,52
RP of meat (1 kg)	0,27	0,13	0,63	0,69	1,00	2,64	0,49	0,32
RP of flour (1 kg)	0,12	0,06	0,24	0,30	0,58	1,00	0,22	0,15
RP of M.P.C.	0,66	0,32	1,50	1,65	3,31	6,65	1,00	0,71
RP of dollar	0,98	0,47	2,19	2,36	5,03	9,52	1,50	1,00

Table 6: Matrix of the quantity of goods that could be bought by a given good (lines) in average on Bavarian black markets in 1947.

Comparison of the level of price dispersion across periods and countries.

The level of both the coefficient of variation and the range constitutes a clear indication that the law of one price did not hold on the spatial dimension both in 1947 and 1948. Moreover the comparison of the coefficients of variation (CV) of the goods of our sample with those found in the literature³⁹ (see table 3 in the appendix) shows that they were higher on black markets than on other markets. The coefficient of variation of sugar was for example 6.4% in US individual stores in 1901 while it was 48 % in our sample. Those of other durable goods such as grain or tea also exhibited a dispersion of about 10 % in the literature but it was three times higher for coffee in our sample. A perishable product such as flowers had a coefficient of variation of 36.3 % in 2000 in US individual stores but the one of meat is two times higher in our sample (70 %) while butter has a comparable measure of price dispersion. The dispersion of the prices of potatoes varied from 8.34 % to 14.94% while the coefficient of variation of flour was greater than 50 %. Although it could be that differences in quality can explained a big coefficient of variation, the number that characterized the dispersion of the prices of coffee, flour, MPC, dollars are still higher than those documented in other studies.

Good	year	Mean prices	Coefficient of variation	Data source	# of observations	reference
Granulated sugar (USA)	1901	46 USD	6.4%	Individual stores	263	Eckard (2004: 103)
Farm salt (USA)	1901	0.61 USD	26.2%	Individual stores	141	Eckard (2004:103)
Grain (Europe)	1742-85	-	10.88%	Market price	15	Shiue & Keller, (2004)
Rice	1742-95	-	19.8 % - 23.8 %	Market price	121	Keller & Shiue (2007)
Potatoes	1976	0.29 USD	14.94%	Individual stores	9	Scholten & Smith (2002)
Potatoes	2000	0.36 USD	8.34%	Individual stores	4	Scholten & Smith (2002)
Tea	2000	2.38 USD	11.1%	Individual stores	9	Scholten & Smith (2002)
Flowers	2000	42.65 USD	36.30	Individual stores	12	Scholten & Smith (2002)

Table 7: Coefficient of variation in other empirical studies

Computing Moran's I statistics

The computation of the Moran's statistic needs to define a matrix of the interrelation between districts. This weight matrix $\{w_{ij}\}$ in which $w_{ij} = 1$ if the i th and the j th district are spatially connected and $w_{ij} = 0$ otherwise. Spatial connectedness is here defined at the first order of contiguity relationships. This implies that w_{ij} is set to one when two districts are neighbours and zero when they are not.⁴⁰ For a given year and good, the Moran's I statistic or spatial autocorrelation coefficient is given by:

$$I = \left(\frac{n}{\sum_{i=1}^n \sum_{j=1}^n w_{ij}} \right) \left(\frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij} (x_i - \bar{x})(x_j - \bar{x})}{\sum_{i=1}^n (x_i - \bar{x})^2} \right)$$

³⁹ Most of the literature computes only the standard deviation of the prices of their sample. As argued, this measure is sensitive to the level of prices. Those papers were then not included in our survey as they cannot be compared with our indicator of price dispersion.

⁴⁰ All spatial statistics have been computed using Geoda (<https://www.geoda.uiuc.edu/>).

where i and j are two distinct districts, n is the number of districts, x_i is the price of the good in district i and \bar{x} is the mean of prices. Under the null hypothesis that the x_i are identically and independently distributed normal variables, the expected value of the Moran's statistic is $E[I] = (N-1)^{-1}$. Table 3 reports the results of Moran's I .

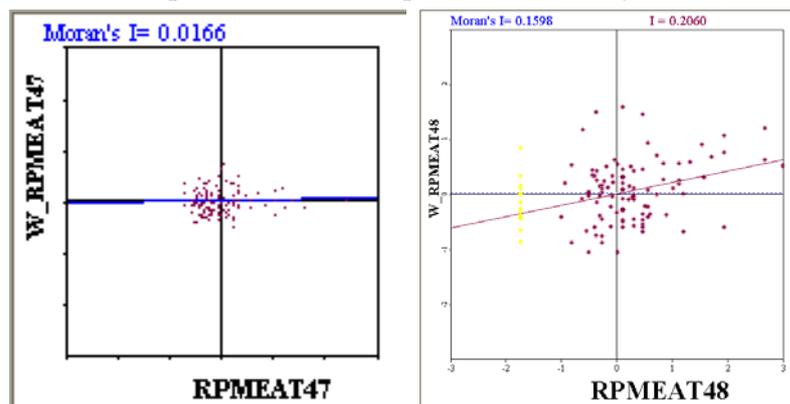
To test whether the spatial distribution of prices was random or ordered, I run a statistical test whose logic is the following. If the number of regions is large the sampling distribution of I under the null hypothesis of no spatial pattern approaches the Normal distribution, then the mean and the variance of I can be used to create the statistic $Z = (I - E[I]) / \sqrt{\text{Var}(I)}$ whose value can be compared with the critical value of the Normal table. At a significance level of 5%, a value of Z greater than 1.96 or -1.96 will indicate that the spatial pattern is characterized by spatial autocorrelation.

Z(I)	Butter	Coffee	Sugar	Cigarettes	Meat	Flour	M.P.C	U.S.D.
For nominal prices in 1947	-1.46	-0.46	1.55	0.34	0.25	0.81	0.70	-0.17
For RP in cigarettes in 1947	0.14	1.24	1.63	/	0.10	1.16		
For nominal prices in 1948	0.31	0.50	-1.56	1.14	1.01	1.33	1.53	2.00
For RP in cigarettes in 1948	1.36	1.21	-1.04	/	3.03	0.98	2.08	2.33

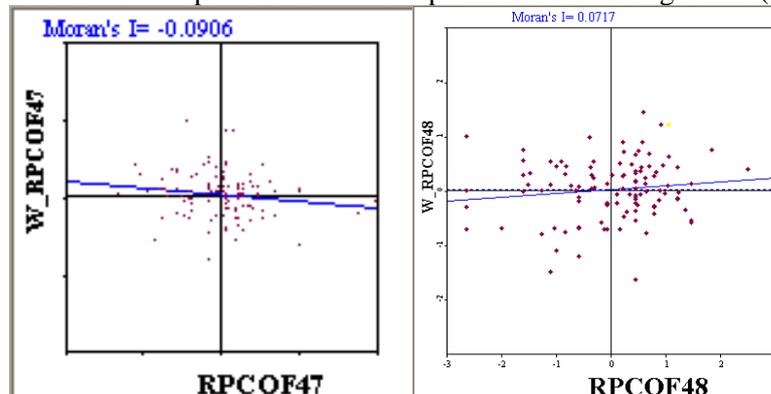
Table 8: Z statistic of spatial autocorrelation

The four quadrants in the graph provide a classification of four types of spatial autocorrelation: *high-high* (upper right), *low-low* (lower left), for positive spatial autocorrelation; *high-low* (lower right) and *low-high* (upper left), for negative spatial autocorrelation. The slope of the regression line is Moran's I , listed at the top right of the graph (in blue).

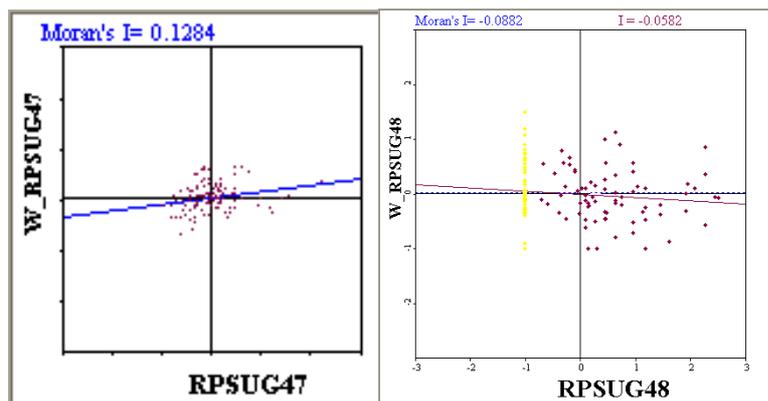
Moran's scatterplot for the relative price of meat in cigarettes (left: 1947, right: 1948)



Moran's scatterplot for the relative price of coffee in cigarettes (left: 1947, right: 1948)



Moran's scatterplot for the relative price of sugar in cigarettes (left: 1947, right: 1948)



Results of OLS regression for relative prices in cigarettes

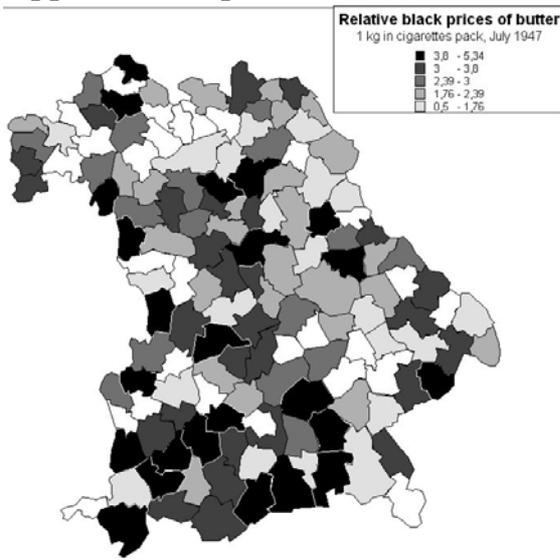
<i>Relative prices, July 1947</i>	Butter	Coffee	Sugar	Meat	Flour
Population density	-0,0007	0,0016	0,0005	1,1 E-5	0,0002
Mean wage	0,0012	-0,023*	-0,0018	-0,0021	-0,0008
Supply side variable	0,0103		-0,00023	0,0032	-0,754*
Constant	2,481		1,602	0,902	0,485
Jarque Berra test	no	yes	yes	yes	yes
Adjusted R ²	0%	4,30%	0%	0%	9,62%
# of observations	116	116	116	116	96

<i>Relative prices, July 1948</i>	Butter	Coffee	Sugar	Meat	Flour
Population density	0,0003	0,0009	-0,0042	0,002	3,32 E-5
Mean wage	0,0094***	-0,011	4,79 E-5	0,0017	-9.147 E-5
Supply side variable	0,0023		0,0049	0,0102***	0,136
Constant	1,01	6,57	-0,042	0,484	0,232
Jarque Berra test	yes	yes	yes	no	yes
Adjusted R ²	1,46 %	0 %	0,89 %	1,46 %	0 %
# of observations	116	115	76	103	96

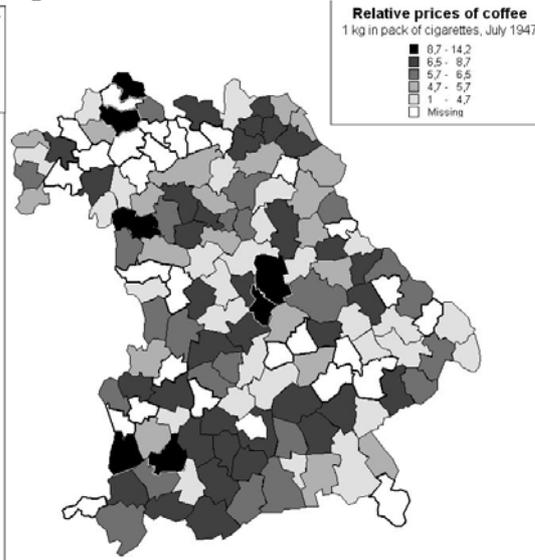
	density of dairy cow	Density of pigs	Density of population	Mean industrial wage	Share of wheat	Share of sugar
Moran's I statistic	0,4296	0,5515	0,1267	0,1927	0,5259	0,4099
E(I) = 1/(n-1)	0,0087	0,0087	0,0087	0,0087	0,0087	0,0087
Standard deviation	0,0718	0,0671	0,0584	0,065	0,0698	0,0618
Z(I)	5,862	8,089	2,021	2,831	7,410	6,492

Table 9: Moran's I statistics for right hand-side variables

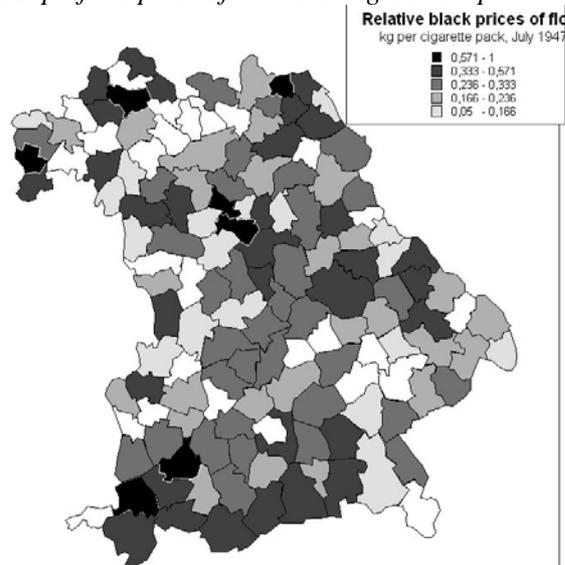
Appendix 3: Spatial distribution of the prices in 1947



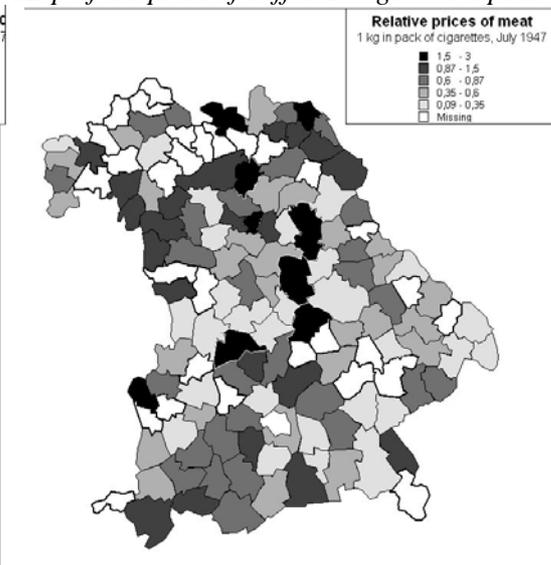
Map of the price of butter in cigarette's pack



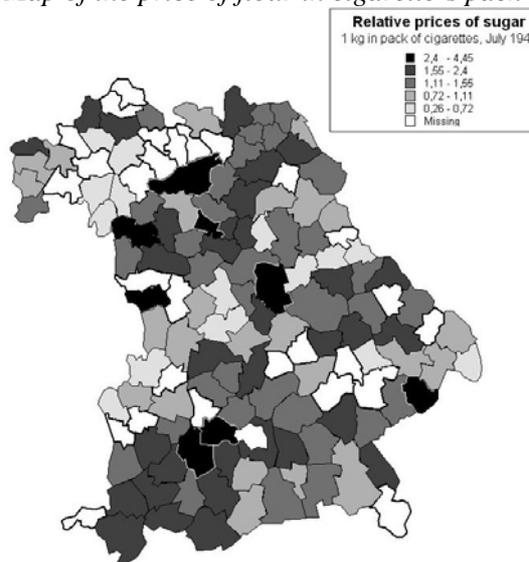
Map of the price of coffee in cigarette's pack



Map of the price of flour in cigarette's pack

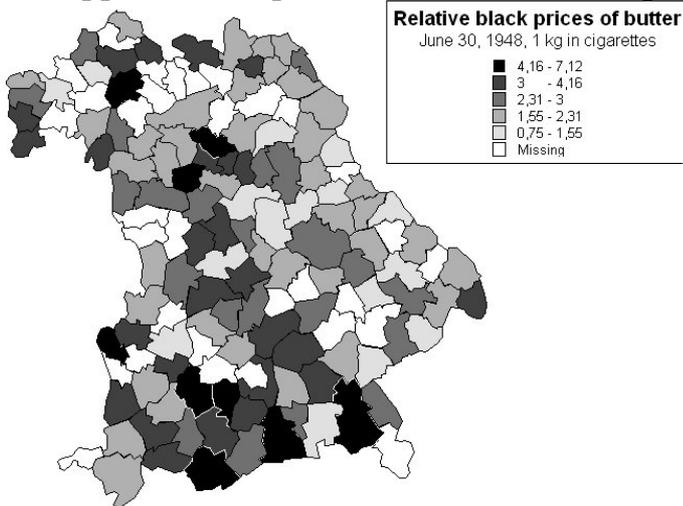


Map of the price of meat in cigarette's pack

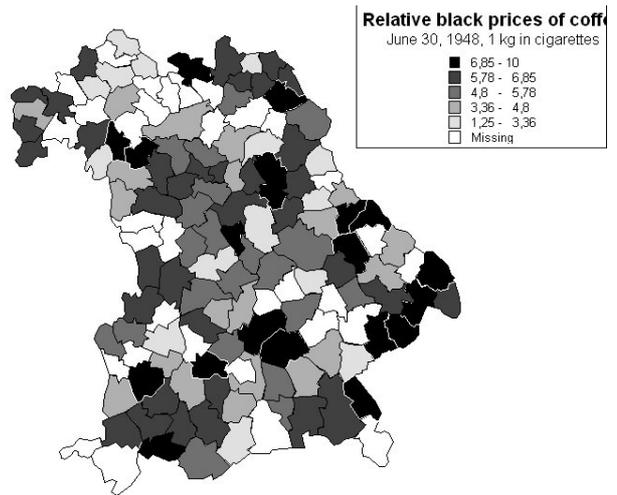


Map of the price of sugar in cigarette's pack

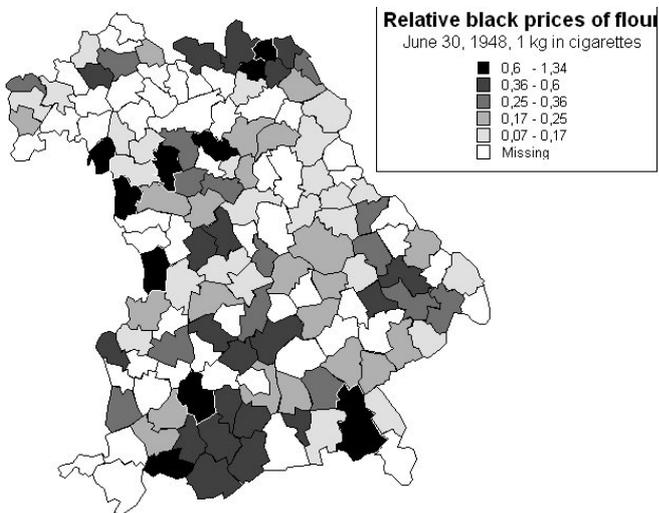
Appendix 4: Spatial distribution of the prices in 1948



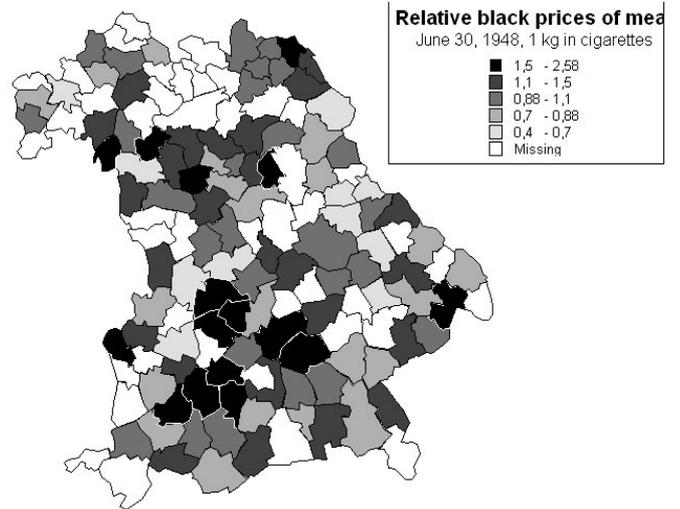
Map of the price of butter in cigarette's pack



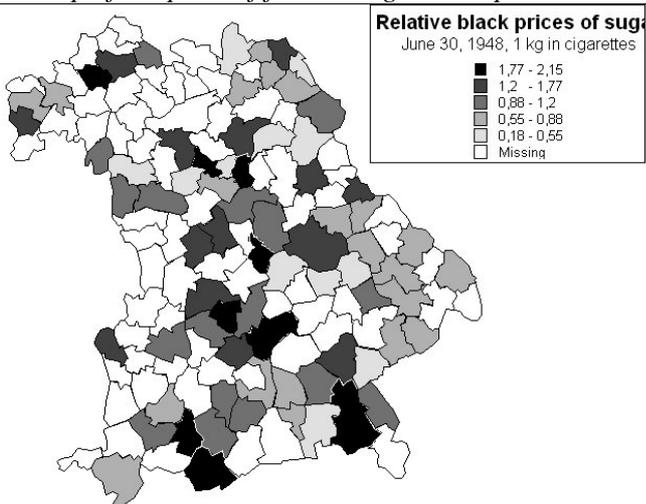
Map of the price of coffee in cigarette's pack



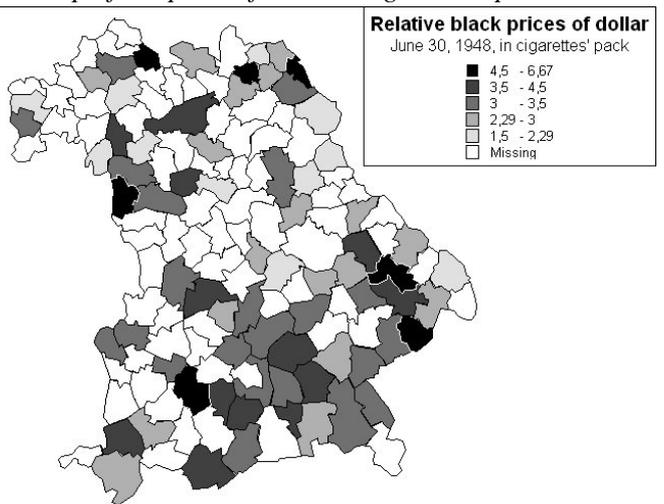
Map of the price of flour in cigarette's pack



Map of the price of meat in cigarette's pack



Map of the price of sugar in cigarette's pack



Map of the price of dollar in cigarette's pack