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GUERRERO, Cecilia
Heinrich Heine University Düsseldorf

MORI, Tomoya
RIETI

WRONA, Jens
University Duisburg-Essen, CESifo, DICE

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Research Institute of Economy, Trade & Industry, IAA

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Culture, Tastes, and Market Integration: Testing the Localized Taste Hypothesis*

Cecilia Guerrero (Heinrich Heine University Düsseldorf)†
Tomoya Mori (Kyoto University, RIETI)‡
Jens Wrona (University Duisburg-Essen, CESifo, DICE)§

Abstract

Using monthly price data from the Survey of Wholesale Markets for Fruits and Vegetables of Japan, we demonstrate that regional taste differences are an obstacle to inter-regional market integration. We propose a novel strategy for identifying the causal effect of localized tastes on bilateral market integration. We use the spatial distribution of historical dialects in Japan to measure historical-cultural proximity, which can be used as an instrument for the persistent dissimilarity in local food preferences. In accordance with the localized taste hypothesis, we find that regions which historically did not share a similar dialect/culture are characterized by persistent taste differences, explaining the lack of bilateral market integration among these regions.

Keywords: Market Integration, Localized Tastes, Culture, Cointegration analysis
JEL classification: D12, F15, N75, Q11, R22, Z13

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† Heinrich Heine University Düsseldorf, Düsseldorf Institute for Competition Economics (DICE), Universitätsstr. 1 40225 Düsseldorf, Germany, e-mail: guerrero@dice.hhu.de.
‡ Kyoto University, Institute of Economic Research, Yoshida-honmachi, Sakyo-ku, Kyoto 606-8501, Japan; e-mail: mori@kier.kyoto-u.ac.jp.
§ University Duisburg-Essen, Mercator School of Management (MSM), Institute of East Asian Studies (IN-EAST), Lotharstraße 65, 47057 Duisburg, Germany, e-mail: jens.wrona@uni-due.de.

1 Introduction

This paper proposes a novel identification strategy to estimate the causal effect of localized tastes on the bilateral integration of regional markets. In order to predict persistent historical taste patterns that have been passed on through generations, we construct a cultural proximity instrument based on the historical distribution of Japanese dialects from the Linguistic Atlas of Japan (cf. Tokugawa and Masanobu, 1966).

In accordance with the localized tastes hypothesis (cf. Head and Mayer, 2013), we argue that persistent inter-regional taste differences historically emerged from the exclusive availability of locally produced varieties in a pre-modern era of high transportation cost. Before rapid, cheap, refrigerated transportation became widely available, consumers naturally consumed locally available varieties. Children would be habituated to the tastes of local varieties, and producers would develop skills in manufacturing these inputs. These production-side improvements would provide additional incentives for taste adjustment, and cultural evolution would create differences in preferences that are expected to persist even after falling transportation costs had driven down price differences between formerly separated markets.

Because local tastes and regional cultures developed together in this evolutionary process, we argue that historical cultural proximity can be used to predict today's dissimilarity in regional tastes. Following Falck et al. (2012), we use the overlap in historical dialects among regions in Japan to construct a comprehensive cultural proximity measure, which summarizes all past interactions that could have led to a cultural convergence and/or to possible transmission of local tastes. Because tastes historically were transmitted either through trade or through migration (cf. Head and Mayer, 2013), we expect that previously more connected regions not only share more similar historical dialects but also are characterized by a substantial overlap in their persistent regional preferences. Using past cultural proximity measured by the overlap in historical dialects as an instrument for the present day dissimilarity in regional tastes therefore allows us to identify the negative and highly significant effect of persistent differences in spatial food preferences on the integration of local markets.

To measure the bilateral integration among 72 Japanese wholesale markets for fruits and vegetables, we follow two different approaches, both of which rely on detecting systematic deviations from the law of one price. Following Engel and Rogers (1996) we first compute a measure of price volatility based on the monthly changes in the log relative market price for a specific market pair. As an alternative, we follow Shiue and Keller (2007) as well as Bernhofen et al. (2017), who measure bilateral market integration based on the co-movement of monthly price averages, which we construct as a time series (2010-17) based on the Survey of Wholesale Markets for Fruits and

Vegetables in Japan. Market (dis)integration thereby is measured as a deviation from the law of one price, relying on a cointegration test (cf. Engle and Granger, 1987) that postulates a long-run relationship between average market prices, and which examines how the average price gap between market pairs evolves. Because average market prices depend on the composition of local consumption baskets, which in return are determined by the vector of localized tastes, we expect that average market prices are more similar and converge faster if local food preferences overlap.

Measuring the overlap in market-specific preferences is a non-trivial task because individual tastes cannot be observed directly. We therefore proceed in two steps: To obtain a rough measure for gauging the dissimilarity in local food preferences, we compute commodity-specific (average) expenditure shares throughout the entire sample period (2010-17). The average dissimilarity in market-specific tastes is then approximated by the Manhattan distance between these commodity-specific expenditure shares. In a second step, we refine our measure of taste dissimilarity by estimating market-specific taste parameters for 31 fruits and vegetables covered by the Japanese Family Income and Expenditure Survey. Following Atkin (2013) and Colson-Sihra et al. (2020) we employ an Almost Ideal Demand System (cf. Deaton and Muellbauer, 1980) to identify market-specific taste intercepts, which subsequently can be used to construct the Manhattan distance between taste parameters as a comprehensive measure of market-pair-specific average taste dissimilarity.

To identify the effect of localized tastes on bilateral market integration, we exploit persistent local taste differences as a source of exogenous variation. Because localized tastes emerged from an evolutionary cultural process, in which initially small differences between locally produced varieties are propagated over time (cf. Head and Mayer, 2013), we can use historical cultural proximity as a proxy for historical taste similarities. By constructing a cultural proximity index based on the spatial variation in historical dialects, we follow Falck et al. (2012), who argue in favor of a comprehensive summary measure reflecting all the past social and economic interactions between regions that leave permanent imprints in the regions' local dialects. As our primary data source for constructing a historical cultural proximity index, we are using the Linguistic Atlas of Japan based on a survey conducted by Japan's National Language Research Institute between 1957 and 1964. The Linguistic Atlas of Japan covers 284 dialect maps, which display the spatial distribution of dialect realization for 250 prototypical words across approximately 2,400 locations from all over Japan, which were reported by male informants who were born before 1903.

As the main result of our analysis we find that differences in localized tastes predicted by the historical cultural proximity among Japanese markets are an important reason for the law of one price to fail. Wholesale markets whose customers for historical reasons share a more similar set of local preferences are generally more integrated. This important result holds irrespective of how the bilateral integration of markets or the dissimilarity in localized tastes is measured and is robust against the inclusion of additional geographic instrumental variables (in particular bilateral distance). While our OLS estimates are generally biased against zero, we also find that the factor by which our IV estimates exceed the corresponding OLS estimates becomes smaller when the dissimilarity in regional tastes is measured more precisely by accounting for price and income effects. We acknowledge that these first results are compatible with an erroneous measurement of localized tastes as our main explanatory variable but do not imply that other sources of endogeneity such as reversed causality (cf. Colson-Sihra et al., 2020) can be dismissed as an identification threat.

Head and Mayer (2013) summarize the existing evidence on the localized tastes hypothesis and conclude that despite the strong empirical evidence on the importance of regional taste differences (cf. Bronnenberg et al., 2012; Atkin, 2013, 2016) there exists only indirect evidence for the extent to which these preference differences are responsible for a lack of bilateral market integration. One obvious reason for the lack of such direct evidence is unobserved heterogeneity, which makes it difficult to isolate the taste channel: Although it is straightforward to identify taste-sensitive products in highly disaggregated international trade statistics, it is difficult to relate measures of market integration for these products to taste differences between countries, which may also differ in terms of other factors such as history, language, and institutions (cf. Melitz, 2008; Head et al., 2010; Melitz and Toubal, 2014).

The trade literature therefore has taken a more indirect approach, showing that trade in taste-sensitive goods differs from aggregate trade, without providing an explicit explanation for these differences. Blum and Goldfarb (2006) show for example that the distance elasticity in a gravity model of trade in "weightless" products is particularly high (≈ -3) for taste-sensitive digital products, such as music, games, and pornography. Similarly, Hellmanzik and Schmitz (2015) find that trade in taste-sensitive audiovisual services responds more sensitive to larger distances than total service trade. Ferreira and Waldfogel (2013) show that music market shares follow a gravity model, and find a much smaller distance elasticity, which is however significantly different from zero despite the absence of transportation costs.

By comparing French imports between the Canadian provinces of Quebec (French ancestry share of 79%) and Ontario (French ancestry share of 36%) across six typically French food categories (Roquefort, Cheese, Jam-bon, Champagne, Wine, and Saucisse) Head and Mayer (2013) show that the French share is considerably higher in Quebec than in Ontario. Interestingly, a somewhat similar – although slightly weaker – pattern also arises for taste-insensitive industrial goods (Trucks, Metres, Hand Tools, Safety Glass, Electronical Machinery, and Medical Equipment), which suggests that localized tastes may not be the only explanation for the French bias in Canadian imports, and that the taste channel has to be carefully distinguished from alternative explanations (e.g. common language, institutions, etc.).

This paper is structured as follows: In Section 2 we describe how to measure the bilateral integration of wholesale markets for fruits and vegetables. In the subsequent Sections 3 and 4, we then explain how to measure regional taste differences and how to construct our cultural proximity instrument. Section 5 explains our identification strategy and reports our main results. Section 6 concludes.

2 The Integration of Japanese Fruit and Vegetable Markets

In the following, we describe how to measure the bilateral integration of wholesale markets for fruits and vegetables. For this purpose, we first introduce the Survey of Wholesale Markets for Fruits and vegetables of Japan as our primary data source in Subsection 2.1. We proceed by defining two alternative measures of bilateral market integration in Subsection 2.2, which subsequently are explored in Subsection 2.3.

2.1 Data

To study how the integration of regional market for taste-sensitive goods is shaped by local preferences, we focus on Japan's 72 most important regional wholesale markets for fruits and vegetables (listed in Table A.2). Using the Survey of Wholesale Markets for Fruits and Vegetables (*Seikabutsu Oroshiuri-Shijo Chosa*), which is compiled by the Ministry of Agriculture, Forestry and Fisheries (MAFF), allows us to observe average sales and quantities for 17 fruits and 48 vegetables at a monthly frequency from 2010 to 2017. Out of these 65 commodities 10 fruits and 21 vegetables can be matched to the Japanese Family Income and Expenditure Survey (listed in Table A.1). In the following, we are focusing on these 31 commodities in our benchmark specification. Monthly market-level transactions are further differentiated according to the type of and the location of their supplier. The data thereby distinguishes three possible sources: foreign producers, domestic producers, and other domestic wholesale markets for fruits and vegetables. Ignoring all imports, we are focusing on domestic producers, which are identified in terms of their location (i.e. one of Japan's 47 prefectures), and on other domestic markets that are included in our data as possible sources. For each source we compute monthly commodity prices by dividing the sales originating from this source by the corresponding quantities. Market-specific commodity prices are then computed as a weighted mean of the source-specific monthly commodity prices, using the market shares of the respective transactions as aggregation weights. In order to obtain series of average market prices, we compute market-specific time-invariant aggregation weights by averaging the expenditure shares for the different commodities across the entire sample period (2010-2017). Using these time-invariant aggregation weights, we then compute monthly average market prices as weighted averages over commodity-specific price series.

The by far largest part of all transactions link markets to domestic producers and not to other domestic markets. To evaluate the bilateral integration of regional markets, we therefore focus on the integration of market prices rather than on the trade volumes between markets. Being able to observe wholesale rather than retail prices thereby has several key advantages: Because the exact location of wholesale markets is known, we can match market outcomes with high precision to the surrounding region's local preferences and its historical culture (see also below). Whereas retail prices are expected to reflect the structure of local retail markets, wholesale prices are determined at locally confined and similarly organized spot markets. Wholesale prices are therefore expected to depend primarily on forces of supply and demand (such as localized tastes). At the demand side wholesale prices thereby are not only determined by purchases for private consumption. In Japan – where eating out is very popular – wholesale prices also reflect the demand for fruits and vegetables from local restaurants and other food producers, which often have an important role in preserving localized taste patterns.

2.2 Measuring Bilateral Market Integration

In order to measure the bilateral integration of Japanese wholesale markets for fruits and vegetables, we analyze the comovement of average market prices across market pairs. Following the market integration literature, we focus on two different measures of bilateral price integration, which both rely on deviations from the law of one price to quantify the extent of imperfect market integration.

As a benchmark, we follow the seminal paper by Engel and Rogers (1996), who focus on the volatility in relative prices across market pairs in order to determine the degree of the failure of the law of one price. By computing the standard deviation of monthly changes in the log of relative prices across market pairs, we obtain a measure of bilateral market integration which reflects the degree to which average prices differ across markets and the extent to which inter-marker price differentials vary over time. Formally Engel and Rogers's (1996) price volatility measure is defined as follows: Denoting the average price in market i at time t by P_{it}, we can compute the log of the relative price in market i versus market j as $\mathcal{P}_{ijt} \equiv \ln(P_{it}/P_{jt})$. The volatility of $\mathcal{P}_{ijt}$ can then be computed as the standard deviation of the monthly changes in $\mathcal{P}_{ijt}$. Table A.2 reports the average price volatility for 72 Japanese wholesale markets for fruits and vegetables (averaged across all partner markets) to document that the law of one price typically is violated.

As an alternative to the price volatility measure proposed by Engel and Rogers (1996), we follow Shiue and Keller (2007) and Bernhofen et al. (2017) in conducting a cointegration test of market integration, which postulates a long-run relationship between the average market prices P_{it} and P_{jt}, and examines how the price gap between market pairs evolves over time. We thereby distinguish between a non-stationary process if the price gap becomes arbitrarily large over time and a stationary process if average prices levels converge. To obtain our measure of bilateral market integration we proceed in two steps: At first we run a linear Engle and Granger (1987) cointegration regression on the average prices P_{it} and P_{jt}

$$\ln P_{it} = \rho + \sigma \ln P_{jt} + \varepsilon_{ijt}, \tag{1}$$

with estimation parameter σ, constant ρ, and error term ε_{ijt}. Following Shiue and Keller (2007) and Bernhofen et al. (2017) we control for seasonality and outliers through a set of accordingly specified dummy variables.[1] In a second step the market pair-specific series of residuals $\hat{\varepsilon}_{ijt}$ from Eq. (1) are then separately investigated in augmented Dickey-Fuller (ADF) regressions

$$\Delta\hat{\varepsilon}_{ijt} = \delta_{ij}\hat{\varepsilon}_{ijt-1} + \sum_{\hat{t}=1}^{T} \psi_{\hat{t}} \Delta\hat{\varepsilon}_{ijt-\hat{t}} + \xi_{ijt}, \tag{2}$$

in which ξ_{ijt} denotes the error term. As default the augmented Dickey-Fuller regressions in Eq. (2) are allowed to have two lags (i.e. $T = 2$). Our parameter of interest is δ_{ij}. If average prices for the markets i and j are cointegrated, we expect strong statistical support in favor of $\delta_{ij} < 0$, which means that average prices are converging in the long run. For $\delta_{ij} = 0$ the residual series is non-stationary. We interpret the non-convergence of average prices in i and j then as evidence for a lack of bilateral market integration. Following Shiue and Keller (2007), we therefore adopt the (absolute) value of the t-statistic associated with δ_{ij} as a measure for the degree of bilateral market integration. Table A.2 reports for each wholesale market the average level of market integration as an unweighted mean of the absolute values of t-statistics from the above regressions.

2.3 Descriptive Analysis

In Table 1, we report descriptive evidence on how our preferred measures of bilateral market integration depend on a set of geographic variables. As geographic controls, we include log real-road distance between markets and a set of regional border dummies. We thereby account for three different levels of regional aggregation: At the lowest level, we distinguish between 46 prefectures (excluding the remote island of Okinawa) as the most important sub-national units of administration. At the intermediate level of aggregation we account for 8 regions (again excluding the remote

[1]For our monthly specification we include a dummy variable for each calendar month (except one). We also add an outlier dummy to the regression in Eq. (1), which indicates time periods in which the growth rate of the average prices P_{it} and P_{jt} exceeds the long-run standard deviation of the respective price series in logs.

Table 1: *Descriptive Analysis: Market Integration and Geography*

Bilateral integration of the markets i and j								
Measure:	**Relative price volatility**				**Price cointegration**			
Model:	**OLS-FE**				**OLS-FE**			
Specification:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
ln Distance$_{ij}$	0.0032***	0.0030***	0.0031***	0.0010	−0.0458***	−0.0539***	−0.0592***	−0.0159
	(.0004)	(.0004)	(.0006)	(.0006)	(.0136)	(.0159)	(.0225)	(.0269)
Prefecture border dummy$_{ij}$		0.0020	0.0020	0.0046		0.1052	0.1043	0.0492
		(.0032)	(.0032)	(.0032)		(.0777)	(.0777)	(.0804)
Region border dummy$_{ij}$			−0.0002	0.0005			0.0177	0.0038
			(.0015)	(.0015)			(.0486)	(.0484)
East-West border dummy$_{ij}$				0.0045***				−0.0929***
				(.0008)				(.0310)
Fixed effects:								
Market fixed effects:	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Number of observations:	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112
R^2:	0.990	0.990	0.990	0.990	0.972	0.972	0.972	0.972

Notes: Table 1 regresses two measures of bilateral market integration on a set of geographic control variables (bilateral distance and a set of intra-national border fixed effects) and the complete set of market-specific fixed effects (omitting constant terms from the regressions). Specifications (1) to (4) measure bilateral market integration through the standard deviation in the monthly changes of the log relative price indices for all market pairs $i \times j$. Specifications (5) to (8) measure bilateral market integration as the absolute value of the t-statistics obtained from augmented Dickey-Fuller regressions of market-pair-specific residual prices. Market-specific price indices are computed as monthly averages for 96 months from Jan. 2010 to Dec. 2017. Robust standard errors; significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

island of Okinawa). At the highest level of aggregation we follow Wrona (2018) and distinguish between the East and the West of Japan as two non-overlapping country parts.[2] For each level of aggregation we compute a border fixed-effect, taking a value of zero if both markets of a given market pair are located in the same regional unit (prefecture, region, etc.) and a value of one otherwise. The accordingly defined border dummies account for the effect of administrative borders (among prefectures and regions) and for discontinuous distance effects. Although there exists neither a present nor a past East-versus-West border in Japan, Wrona (2018) finds that there is substantially less intra-national trade between the East and the West of Japan than within each of the respective country parts. To account for the possibility of a comparable East-West bias, we include the East-West border dummy here as well. Following Engel and Rogers (1996), we also include a set of market-specific fixed effects. Market-specific fixed effects are defined such that for the market pair $i \times j$ the dummy variables D_i and D_j take a value of one whereas all other dummy variables D_n with $n \neq i, j$ are muted. In this way we account for all market-specific monadic variation in our bilateral market integration measure m_{ij}.[3]

[2] See Figure A.1 for the definition of prefectures, regions and the East-versus-West division.

[3] Omitting the constant regression term, we can write the estimation equation from which the results of Table 1 are obtained as

$$m_{ij} = \mathbf{X}'_{ij}\beta_{ij} + \sum_{n=1}^{N} \mu_n D_n + \varepsilon_{ij},$$

in which m_{ij} is a placeholder for our preferred market integration measures, $\mathbf{X}_{ij}$ is a vector of geographic control variables, $D_n \in \{0, 1\}$ is a dummy variable for each market $n = 1, \ldots, 72$ in our sample, and ε_{ij} is the idiosyncratic

In Table 1 we compare the impact of geography on our preferred measures of market integration. Specifications (1) to (4) thereby are based on the volatility in log relative market prices, whereas the Specifications (5) to (8) report the effects on the absolute values of the *t*-statistics of the ADF residual price regressions from our cointegration analysis. Both market integration measures display the same basic pattern: Geographic distance has a negative effect on bilateral market integration as long as we do not account for the East-West-border dummy. Once, we account for a possible East-versus-West bias the (absolute value of the) point estimate distance coefficient becomes much smaller and statistically indistinguishable from zero.[4] Neither prefecture nor region borders seem to matter for bilateral market integration. The East-West border dummy is associated with negative effect on bilateral market integration, which is in line with the findings of Wrona (2018).

To rationalize the insignificant distance effects in the Specifications (4) and (8) of Table 1, we may recall that most of the underlying transactions, based on which average market prices are computed, do not reflect interactions between a pair of wholesale markets but between a wholesale market and some local producers of the respective good. Instead of observing large inter-market trade volumes, which would be a sign of direct arbitrage, we find that most markets are only indirectly integrated through sharing a set of common supply prefectures. In this case the bilateral integration of markets should not depend on the inter-market distance but on the joint distance that both markets have to their shared supplier. Following this logic, one may also be tempted to interpret the negative effect of the East-West border on bilateral market integration as the result of a polarized supply network structure. If wholesale markets from a certain country part are more likely to be linked through sharing a common set of regionally confined suppliers, we would indeed expect that markets are relatively better integrated within their respective country parts.

3 Localized Tastes in Japan

3.1 Data

In order to measure regional differences in the preferences for fruits and vegetables, we compute two proxies for local tastes, which are based on two different data sources. In a first step, we use market-specific average expenditure shares (2010-2017) from the Survey of Wholesale Markets for Fruits and Vegetables to proxy persistent local taste patterns. In a second step we then match

error term.

[4]Analysing the effect of distance on volatility of log relative prices Engel and Rogers (1996) report a significant distance coefficient of 0.000495 and a significant border estimate for U.S.-Canadian border of 0.00750 for "food at home". Estimates for "food away from home" are similar in terms of magnitude and significance.

the location of wholesale markets to the Family Income and Expenditure Survey (*Kakei Chosa*) of Japan provided by the Ministry of Internal Affairs and Communications (MIC), which allows us to estimate location-specific taste parameters based on an Almost Ideal Demand System (Deaton and Muellbauer, 1980).

The 2017 wave of the Family Income and Expenditure Survey provides information on the expenditure and on the demographic characteristics of the surveyed Japanese households.[5] Out of 700 different expenditure categories covered by the survey we focus on 31 fruits and vegetables, which we can match to the Survey of Wholesale Markets for Fruits and vegetables. Because families can be assumed to be more firmly tied to the regions they currently living in and therefore more habituated to localized taste patterns, we are focusing in our analysis on multi-member households.[6] In terms of household characteristics, we focus on the household's income, the household size and on the numbers of household members below the age of 18 and above the age of 64. We also observe the industry (18 categories) and the occupation (12 categories) in which the household head is employed.

The Family Income and Expenditure Survey is based on a stratified sampling, which distinguishes between municipalities, unit blocks within municipalities, and households. For 2017 there are 168 sampling units defined at the municipality-level. These units fall into three categories: There are 52 prefecture capitals and government-designated cities that each constitute a sampling unit. Then there are an additional 74 sampling units that consist of municipalities with at least 50,000 inhabitants, which are chosen based on the municipality type (urban/rural), population density, population change, industrial structure, and the age composition of the household heads. Finally, there are an additional 42 sampling units, which consist of municipalities with less than 50,000 inhabitants, which are chosen based on the regional composition, topographical characteristics, and the age composition of household heads. Municipalities are subdivided into unit blocks that roughly share the same population. Between 1300 and 1400 of these blocks are surveyed each month, with 1/12 of the blocks being randomly replaced by other blocks from the same municipality. From each of these blocks six randomly chosen households are surveyed for 6 consecutive months before being replaced by other randomly selected households from this block. By following this stratified sampling scheme the Family Income and Expenditure Survey is designed to provide a detailed representation of how household-level expenditure is distributed across the whole of Japan.

[5]The Family Income and Expenditure Survey in principle also includes data on purchased quantities for each product category. Unfortunately, the quantity information is often missing, which is a common problem in the literature (cf. Colson-Sihra et al., 2020).

[6]We also exclude the following household types: (*i.*) households of a student; (*ii.*) households living in hospitals or similar facilities; (*iii.*) households living in dwellings with shops, hotels, etc.; (*iv.*) households with multiple families; (*v.*) households with more than three live-in maids; (*vi.*) households whose heads are absent for more than three months; (*vii.*) foreign households.

3.2 Measuring Localized Tastes

In order to gauge to what extent markets differ in terms of their local tastes, we compute for each market pair $i \times j$ the Manhattan distance over all commodity-specific expenditure shares. Denoting the market-specific expenditure shares for good g by s_{ig} and s_{jg}, we can compute the Manhattan distance

$$\Lambda_{ij}^{s} \equiv \sum_{g} |s_{ig} - s_{jg}| , \tag{3}$$

which takes a value of zero if expenditure shares are equalized across markets and a value strictly larger than zero otherwise. In order to obtain the above metric, we use the Fruits and Vegetables Wholesale Market Survey and compute market-specific time-invariant expenditure shares as an arithmetic mean over the market-specific monthly expenditure shares. The taste dissimilarity index Λ_{ij}^{s} subsequently is divided by its maximum value to make sure that all index values are distributed on zero-to-one interval.

To account for price and income effects as a possible source for measurement error when approximating local tastes through observed expenditure shares, we follow Atkin (2013) and Colson-Sihra et al. (2020) in using an Almost Ideal Demand System (AIDS) (cf. Deaton and Muellbauer, 1980) to identify regional tastes as residual demand shifters after taking into account the effects of income, prices, and household characteristics. The Almost Ideal Demand System provides several key advantages, which is why it is increasingly adopted to study regional taste patterns (cf. Atkin, 2013; Colson-Sihra et al., 2020). Demand functions derived from an Almost Ideal Demand System are first-order approximations to any set of demand functions that are derived from utility maximisation and allow for a high degree of flexibility in cross-price elasticities. Most important for our application is the additive separability of taste parameters from price and income effect.

Because the number of cross-price elasticities that need to be estimated increases squarely in the number of included products, we follow Nevo (2011) and specify a multi-level demand system. It first distinguishes between four broad commodity categories ("fruit", "vegetable (root)", "vegetable (leaf)", "vegetable (fruit)") which are index by b (a mnemonic for "broad"). In each category, individual products, 31 fruits and vegetables that the Japanese Family Income and Expenditure Survey covers (see also Table A.1), are indexed by g (a mnemonic for "good").

We borrow the specification of the expenditure function of our Almost Ideal Demand System from Atkin (2013) and Colson-Sihra et al. (2020), who allow the first-order price terms in Eq. (4) to be location-specific. Associating each of the 72 wholesale market for fruits and vegetables in our data with the closest city (indexed by mnemonic c) that is covered by the Japanese Family Income and Expenditure Survey therefore allows us to estimate market-specific taste intercepts.

The corresponding minimum expenditure function for household h

$$\ln e(\mathbf{t}_{ck}, \mathbf{p}_{hk}, u) = \text{Const.} + \sum_k t_{ck} \ln p_{hk} + \frac{1}{2} \sum_k \sum_{k'} \theta_{kk'} \ln p_{hk} \ln p_{hk'} + u\phi_0 \prod_k p_{hk}^{\phi_k}, \tag{4}$$

depends on the targeted utility level u, the price vector $\mathbf{p}_{hk}$ for commodities $k \in \{b, g\}$ and the exogenously given vector of city-specific taste parameters $\mathbf{t}_{ck}$. The parameters t_{ck}, $\theta_{kk'}$, and ϕ_k satisfy the following properties: (*i.*) $\sum_k t_{ck} = 1$, (*ii.*) $\sum_k \theta_{kk'} = \sum \phi_k = 0$, and (*iii.*) $\theta_{kk'} = \theta_{k'k} \;\forall\; k, k'$.

The corresponding demand function in budget shares for good level $k = g$

$$s_{hg} = t_{cg} + \sum_{g'} \theta_{gg'} \ln p_{hg'} + \phi_g \ln \left(\frac{X_{hb}}{P_{hb}} \right) \tag{5}$$

can be derived by applying Shephard's lemma and relates household h's expenditure share s_{hg} for commodity g in broad category b to the city-specific taste parameter t_{cg}, the log household prices $\ln p_{hg'}$ for good g' and the household's real expenditure X_{hb}/P_{hg} within the broad category b with P_{hb} as the AIDS price index.

Similarly, we can derive the demand function in budget shares for the broad commodity category $k = b$ as

$$s_{hb} = t_{cb} + \sum_{b'} \theta_{bb'} \ln P_{hb'} + \phi_b \ln \left(\frac{X_h}{P_h} \right), \tag{6}$$

in which t_{cb} denotes the city-specific taste parameter for the broad commodity category b and X_h/P_h is household h's real income with P_h as the AIDS price index for total food consumption.

In order to take the demand function from Eq. (5) to the data we require information on the prices $p_{hg'}$ at which household h purchases commodity g'. Although it is in principle possible to compute unit values for commodities based on the information on quantities purchased by households in the Japanese Family Income and Expenditure Survey, we decide against using the quantity information, which is only erratically reported and most likely measured with error. We rather use the distribution of wholesale prices within municipalities to compute monthly median prices $p_{cg'}$ for commodity g' in city c. The variation in monthly wholesale prices thereby reflects the different locations (i.e. producing prefectures and other wholesale markets) from which commodities are sourced and the possible coexistence of multiple wholesale markets within the same municipality. Household h's demand for commodity g in broad category b in city c from the Japanese Family Income and Expenditure Survey in month τ of the year 2017 then can be estimated based on

$$s_{h\tau g} = t_{cg} + \sum_{g'} \theta_{gg'} \ln p_{h\tau g'} + \phi_g \ln \left(\frac{X_{h\tau b}}{P^{\star}_{c\tau b}} \right) + \mathbf{\Pi H}_{h\tau} + z_\tau + \varepsilon_{h\tau g'}, \tag{7}$$

in which $P^{\star}_{c\tau b} \equiv \sum_{g'} s_{c\tau g'} \ln p_{c\tau g'}$ is the Stone price index for the broad product category b in city c with $s_{c\tau g'}$ as the share of city-wide expenditure on good g' in the broad product category b. Following Subramanian and Deaton (1996) we include a vector of household characteristics $\mathbf{H}_{ht}$ containing the total number of household members, the number of household members younger than 18, the number of household members older than 65, the age and employment status of the household head, as well as two distinct sets of occupation- and industry-specific fixed effects for the household head as additional controls. We also include the complete set of monthly fixed effects z_τ to account for seasonality effect and the error term $\varepsilon_{h\tau g'}$.

Matching the estimated taste parameters $\hat{t}_{cg}$ to markets we can compute the Manhattan distance in market-specific tastes as

$$\Lambda^t_{ij} \equiv \sum_g \left| \hat{t}_{ig} - \hat{t}_{jg} \right|, \tag{8}$$

which can be understood as a comprehensive measure of bilateral taste dissimilarity.

4 Historical Dialects as a Proxy for Cultural Similarity

Section 4 is structured as follows: In Subsection 4.1 we introduce the Linguistic Atlas of Japan, which we then use to a compute a measure of historical dialect similarity in Subsection 4.2. In Subsection 4.3 we finally explore how our cultural similarity measure can be used to predict present taste patterns.

4.1 Data

The Linguistic Atlas of Japan provided by the National Language Research Institute covers 284 dialect maps, which display the spatial distribution of the dialect expressions of 250 prototypical words across approximately 2,400 locations from all over Japan. It is based on a survey conducted between 1957 and 1964, which focused exclusively on male informants born before 1903 and afterward stayed at their birthplace.[7] We use this data to construct a measure of historical cultural similarity based on the overlap in historical dialects.[8] We thereby rely on the previous work of Kumagai (2016), who is building up the Linguistic Atlas of Japan Database, currently containing the raw data of 111 dialect maps from the Linguistic Atlas of Japan. We complement this set maps by georeferencing and digitizing the remaining 173 maps of the Linguistic Atlas of Japan with the help of a Geographic Information System (GIS) application.

[7] See Tokugawa and Masanobu (1966) for more detailed information on the sampling of locations and informants.

[8] All questions (and the corresponding maps) from the Linguistic Atlas of Japan that are used for our analysis are listed in Table A.3.

4.2 Measuring Historical Dialect Similarity

In order to measure historical cultural similarity based on historical dialect data from the Linguistic Atlas of Japan, we use the Jaccard index, which is an established similarity measure in the field of linguistic geography, and which is defined as follows: Let Ω denote the set of all survey questions from the Linguistic Atlas of Japan, and A_i^ω the set of distinct answers obtained in given region i for a given question $\omega \in \Omega$.[9] For given question ω, the similarity in dialects between a given pair of regions i and j can then be measured by the Jaccard index

$$J_{ij\omega} = J_{ji\omega} = \frac{|A_{i\omega} \cap A_{j\omega}|}{|A_{i\omega} \cup A_{j\omega}|} \in [0, 1], \tag{9}$$

where for a given set X the cardinality of this set is represented by $|X|$ (cf. Jaccard, 1901). Averaging across all questions $\omega \in \Omega$ of the Linguistic Atlas of Japan then yields the average overlap in regional dialects

$$J_{ij} = \frac{1}{|\Omega|} \sum_{\omega \in \Omega} J_{ij\omega} \in [0, 1], \tag{10}$$

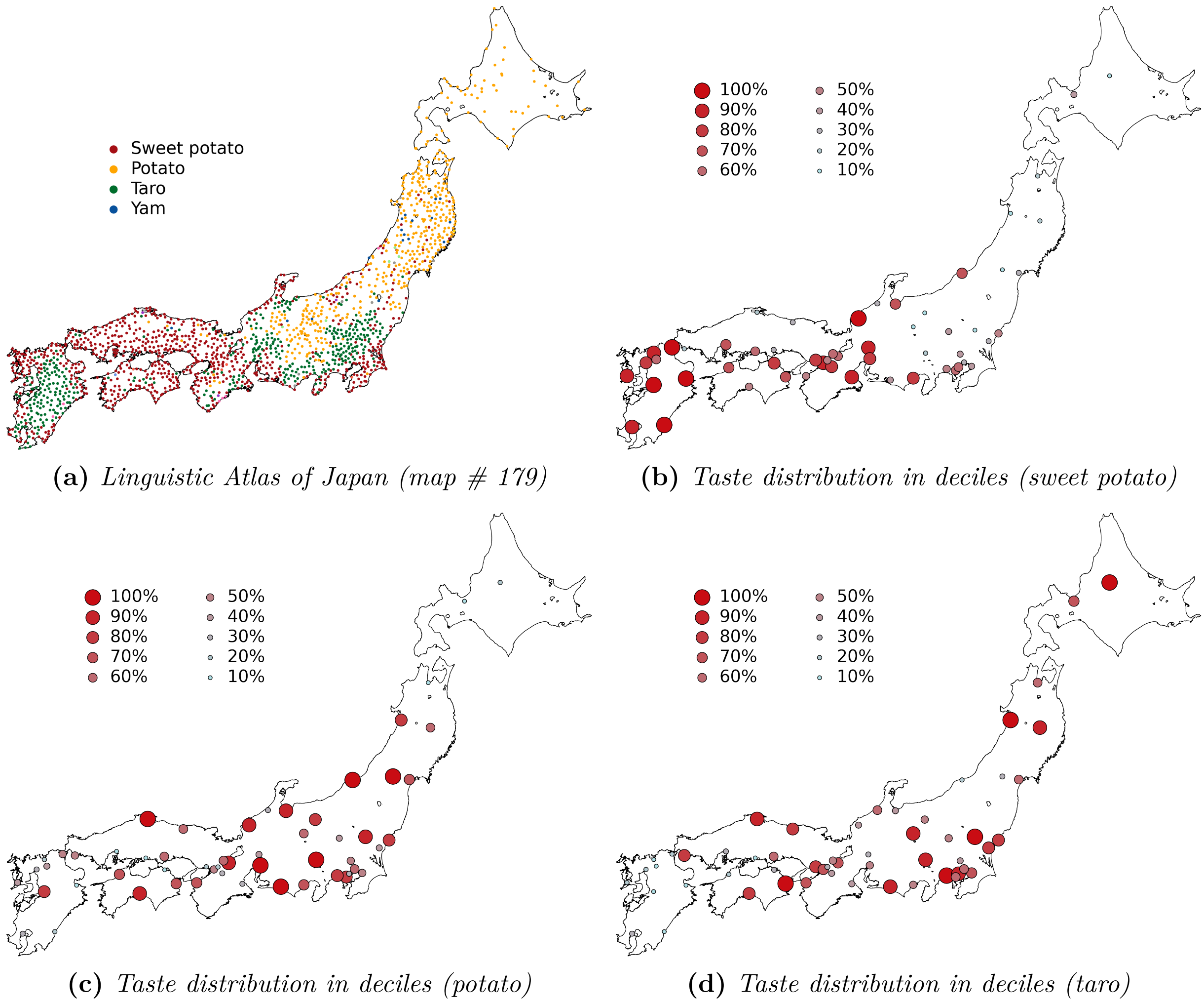
which we use as a proxy for historical cultural similarity. Exploiting the high geographic resolution of the Linguistic Atlas of Japan, we compute the market-pair-specific overlap in historical dialects by focusing on the similarity of regional dialects within a circle of 50 km radius around the location of wholesale markets.

4.3 Descriptive Evidence on Dialects and Tastes

To illustrate that the spatial distribution of historical dialects performs well in predicting contemporaneous taste patterns, we resort to an illustrative example from the Linguistic Atlas of Japan. Question # 189 (map 179) of the Linguistic Atlas of Japan asks "What does the word *imo* (English: tuber) mean: potato? sweet potato? taro?". Subfigure 1a of Figure 1 displays the spatial distribution of answers from the Linguistic Atlas of Japan, which distinguishes between taro (*satoimo*, さといも, 里芋), represented by green dots, potato (*jagaimo*, じゃがいも, じゃが芋), represented by yellow dots, sweet potato (*satsumaimo*, さつまいも, 薩摩芋), represented by red dots, and yam (*yamaimo*, やまいも, 山芋), represented by in blue dots. According to Subfigure 1a the association of "tuber" with "potato" dominates in the Northeast of Japan whereas in the Southwest of Japan the word "tuber" is mainly associated with "sweet potato". The latter fact seems only natural given that the Japanese name *satsumaimo* explicitly links this vegetable to the historical Satsuma province, which was located in southern Kyushu and today is the western part of Kagoshima Prefecture. Yam and taro, which both were cultivated in Japan long before

[9] A_i^ω includes answers from all survey locations within the 50km of road distance around the centroid of region i.

Figure 1: *The spatial distribution of historical dialects and contemporaneous tastes in Japan*



(a) *Linguistic Atlas of Japan (map # 179)*

(b) *Taste distribution in deciles (sweet potato)*

(c) *Taste distribution in deciles (potato)*

(d) *Taste distribution in deciles (taro)*

the arrival of the potato and the sweet potato, are reported much less often as a response in the Linguistic Atlas of Japan. But, they can be found across all parts of the country (except for the most northern island of Hokkaido, whose systematic colonization did not start before the second half of the 19th century).

In the remaining Subfigures 1b, 1c and 1d we plot the spatial distribution of estimated taste parameters for sweet potato, potato, and taro, which are estimated from the Japanese Family Income and Expenditure Survey based on an Almost Ideal Demand System (cf. Deaton and Muellbauer, 1980). We thereby distinguish between 55 different municipalities, which are representative for the locations of the 72 wholesale markets for fruits and vegetables covered by the underlying Survey of Wholesale Markets for Fruits and vegetables.[10] To ensure a better comparability of taste estimates across different commodities, the estimated taste parameters are ranked and sorted into deciles, which we distinguish in the Figure 1 by means of different colors and sizes of circles. In accordance with the distribution of the response “sweet potato” in Subfigure 1a, we identify a systematical

[10]See Subsection 3 for the details of the taste estimation.

divide in the spatial distribution of the estimated taste parameters for sweet potato: While we find that sweet potatoes are highly popular in the Southwest of Japan, we find that the low-ranked taste estimates are concentrated in the Northeast of Japan. Complementary evidence is provided by Subfigure 1c, which shows that in accordance with the distribution of the response "potato" in 1a, potatoes are very popular in central and northern Honshu and rather unpopular in Southern Japan. Interestingly, we find that "potato" as a response in Subfigure 1a dominates Japan's most northern island Hokkaido, which at the same time seems to have comparatively weak local preferences for this commodity. A possible explanation for why the word "tuber" is nevertheless associated with a "potato" is that Japan's most northern island is the by far largest producer of potatoes for the Japanese market. In a similar way the concentrated production of taro in Eastern Kyushu can explain the finding of weak local preferences in Subfigure 1d, which seem to contradict the historical dialect distribution from Subfigure 1a.

Summing up the empirical evidence from Figure 1, we find that the spatial distribution of historical dialects systematically overlaps with the distribution of local food preferences. Historical dialects as a measure for past cultural linkages therefore appear to be a promising candidate for an instrument, that reliably predicts persistent taste differences, while at the same time being uncorrelated with the contemporaneous bilateral integration of wholesale markets.

5 Identifying the Effect of Localized Tastes on Market Integration

To identify the causal effect of localized tastes on bilateral market integration we propose a two-stage least squares (2SLS) estimation approach

$$m_{ij} = \alpha + \beta\,\hat{\Lambda}_{ij} + \sum_{n=1}^{N} \mu_n D_n + \varepsilon_{ij}, \tag{11}$$

which in the second stages regresses our measure of bilateral market integration m_{ij} on our (instrumented) measure of persistent taste differences $\Lambda_{ij} \in \{\Lambda_{ij}^s, \Lambda_{ij}^t\}$ for market pair $i \times j$. Following Engel and Rogers (1996), we introduce a dummy variably $D_n \in \{0, 1\}$ in Eq. (11) for each market $n = 1, \ldots, N$ in our sample. For the market pair $i \times j$ the dummy variables D_i and D_j then take a value of one whereas all other dummy variables D_n with $n \neq i, j$ are muted. In this way we account for the market-specific monadic variation in our bilateral market integration measure m_{ij}. Constant and error term are denoted by α and ε_{ij}, respectively.

In the corresponding first-stage regression

$$\Lambda_{ij} = \kappa + \gamma\, J_{ij} + \mathbf{X}_{ij}'\zeta + \sum_{n=1}^{N} \gamma_n D_n + \xi_{ij} \tag{12}$$

we regress our measure of bilateral taste dissimilarity Λ_{ij} on a constant κ, the cultural similarity index J_{ij}, the same vector of geographical control variables $\mathbf{X}_{ij}$ as in Subsection 2.3, and the complete set of market fixed effects. The error term is denoted by ξ_{ij}.

We summarize the results of our two-stage least squares regressions in the Tables 2 and 3, which distinguish between two different measures of bilateral market integration. In Table 2 bilateral market integration is measured by the volatility in log relative prices (cf. Engel and Rogers, 1996), which we seek to explain by the Manhattan distance over regional expenditure shares from Eq. (3) and by the Manhattan distance over estimated taste parameters from Eq. (8). Both taste

Table 2: *Testing the Localized Tastes Hypothesis (Price Volatility)*

Bilateral integration of the markets i and j (price volatility)								
Estimation:	**2nd Stage**							
Model:	**OLS-FE**	**IV-FE**			**OLS-FE**	**IV-FE**		
Specification:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Manhattan dist. expenditure shares$_{ij}$	0.1399***	0.3278***	0.3237***	0.1800***				
	(0.0105)	(0.0534)	(0.0425)	(0.0436)				
Manhattan dist. estimated tastes$_{ij}$					0.0125***	0.0273***	0.0307***	0.0174***
					(0.0023)	(0.0045)	(0.0039)	(0.0044)
East-West border dummy$_{ij}$				0.0045***				0.0042***
				(0.0007)				(0.0007)
Fixed effects:								
Market fixed effects:	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Number of observations:	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112
R^2:	0.990	0.989	0.989	0.990	0.990	0.990	0.990	0.990
Estimation:	**1st Stage**							
Model:		**OLS-FE**				**OLS-FE**		
Specification:		**(2)**	**(3)**	**(4)**		**(6)**	**(7)**	**(8)**
Historical cultural similarity$_{ij}$		−0.0625***	−0.0145**	−0.0145**		−0.7521***	−0.2807***	−0.2807***
		(0.0063)	(0.0072)	(0.0072)		(0.0237)	(0.0200)	(0.0200)
ln distance$_{ij}$			0.0068***	0.0068***			0.0613***	0.0613***
			(0.0011)	(0.0011)			(0.0034)	(0.0034)
Prefecture border dummy$_{ij}$			0.0092	0.0092			0.1470***	0.1470***
			(0.0060)	(0.0060)			(0.0188)	(0.0188)
Region border dummy$_{ij}$			0.0029	0.0029			0.0076	0.0076
			(0.0020)	(0.0020)			(0.0056)	(0.0056)
East-West border dummy$_{ij}$			−0.0017	−0.0017			0.0081**	0.0081**
			(0.0013)	(0.0013)			(0.0035)	(0.0035)
Fixed effects:								
Market fixed effects:		✓	✓	✓		✓	✓	✓
Summary statistics:								
Number of observations:		5,112	5,112	5,112		5,112	5,112	5,112
R^2:		0.987	0.987	0.987		0.970	0.977	0.977
F-statistic (hist. cult. similarity):		97.5	4.0	4.0		1010.8	197.2	197.2
F-statistic (Kleibergen-Paap):		97.5	36.2	32.7		1010.8	480.9	394.1

Notes: Table 3 presents the 1st- and 2nd-stage results of 2SLS regressions, which at the 2nd stage regresses bilateral market integration, which is measured by the standard deviation in the monthly changes of the relative price indices, on two measures of taste dissimilarity. Regional taste dissimilarity is measured through the Manhattan distance in commodity-specific expenditure shares (cf. Specifications (1) to (4)) and the Manhattan distance in estimated commodity-specific taste parameters (cf. Specifications (5) to (8)), which are obtained from an Almost Ideal Demand System. At the 1st stage historical cultural similarity (approximate by a Jaccard index of historical dialect similarity) and a vector of geographical control variables are used to predict the dissimilarity of localized tastes. Specifications (1) and (5) report the OLS results for comparison. Market-specific price indices are computed across 72 Japanese wholesale markets for fruits and vegetables as monthly averages from Jan. 2010 to Dec. 2017. All regressions include the complete set of market fixed effects. Constant terms are omitted from regressions. Robust standard errors; significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

dissimilarity measures are associated with positive and highly significant OLS estimates in the Specifications (1) and (5), which we interpret as supportive evidence in favour of the localized taste hypothesis. Specifications (2) and (6) account for a potential endogeneity of the OLS estimates

Table 3: *Testing the Localized Tastes Hypothesis (Price Cointegration)*

Bilateral integration of the markets i and j (price cointegration)								
Estimation:	**2nd Stage**							
Model:	**OLS-FE**	**IV-FE**			**OLS-FE**	**IV-FE**		
Specification:	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Manhattan dist. expenditure shares$_{ij}$	−0.6277**	−5.4025***	−4.2192***	−1.0732				
	(0.3003)	(1.9863)	(1.4602)	(1.6374)				
Manhattan dist. estimated tastes$_{ij}$					−0.2324***	−0.4493***	−0.4184***	−0.1150
					(0.0881)	(0.1608)	(0.1241)	(0.1478)
East-West border dummy$_{ij}$				−0.0985***				−0.0954***
				(0.0261)				(0.0271)
Fixed effects:								
Market fixed effects:	✓	✓	✓	✓	✓	✓	✓	✓
Summary statistics:								
Number of observations:	5,112	5,112	5,112	5,112	5,112	5,112	5,112	5,112
R^2:	0.972	0.970	0.971	0.972	0.972	0.972	0.972	0.972
Estimation:	**1st Stage**							
Model:		**OLS-FE**				**OLS-FE**		
Specification:		**(2)**	**(3)**	**(4)**		**(6)**	**(7)**	**(8)**
Historical cultural similarity$_{ij}$		−0.0625***	−0.0145**	−0.0145**		−0.7521***	−0.2807***	−0.2807***
		(0.0063)	(0.0072)	(0.0072)		(0.0237)	(0.0200)	(0.0200)
ln distance$_{ij}$			0.0068***	0.0068***			0.0613***	0.0613***
			(0.0011)	(0.0011)			(0.0034)	(0.0034)
Prefecture border dummy$_{ij}$			0.0092	0.0092			0.1470***	0.1470***
			(0.0060)	(0.0060)			(0.0188)	(0.0188)
Region border dummy$_{ij}$			0.0029	0.0029			0.0076	0.0076
			(0.0020)	(0.0020)			(0.0056)	(0.0056)
East-West border dummy$_{ij}$			−0.0017	−0.0017			0.0081**	0.0081**
			(0.0013)	(0.0013)			(0.0035)	(0.0035)
Fixed effects:								
Market fixed effects:		✓	✓	✓		✓	✓	✓
Summary statistics:								
Number of observations:		5,112	5,112	5,112		5,112	5,112	5,112
R^2:		0.987	0.987	0.987		0.970	0.977	0.977
F-statistic (hist. cult. similarity):		97.52	4.0	4.0		1010.8	197.2	197.2
F-statistic (Kleibergen-Paap):		97.5	36.2	32.7		1010.8	480.9	394.1

Notes: Table 3 presents the 1st- and 2nd-stage results of 2SLS regressions, which at the 2nd stage regresses bilateral market integration, which is measured by the absolute value of the t-statistics obtained from augmented Dickey-Fuller regressions of market-pair-specific residual prices, on two measures of taste dissimilarity. Regional taste dissimilarity is measured through the Manhattan distance in commodity-specific expenditure shares (cf. Specifications (1) to (4)) and the Manhattan distance in estimated commodity-specific taste parameters (cf. Specifications (5) to (8)), which are obtained from an Almost Ideal Demand System. At the 1st stage historical cultural similarity (approximate by a Jaccard index of historical dialect similarity) and a vector of geographical control variables are used to predict the dissimilarity of localized tastes. Specifications (1) and (5) report the OLS results for comparison. Market-specific price indices for the cointegration analysis are computed across 72 Japanese wholesale markets for fruits and vegetables as monthly averages from Jan. 2010 to Dec. 2017. All regressions include the complete set of market fixed effects. Constant terms are omitted from regressions. Robust standard errors; significance: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

by using past cultural similarity (approximated by the proximity of historical dialects) as an instrument for regional taste dissimilarity. Reassuringly, we find that historical cultural similarity is a strong predictor for regional taste dissimilarity, and that regional taste differences are an obstacle for the integration of fruit and vegetable markets in Japan. Accounting for additional geography-based instrument variables (most notably inter-market distance) in the Specifications

(3) and (7) reduces the marginal effect of historical cultural proximity on regional taste dissimilarity and therefore the strength of our instrument. Whereas the Manhattan distance over expenditure shares is predicted by past cultural proximity and the real-road distance between markets, we find that the Manhattan distance over estimated tastes also depends on the prefecture border dummy and the East-West border dummy. Reassuringly, we find that adding more instruments has little effect on second-stage results. In the Specifications (4) and (8) we finally add the East-West border dummy, which according to Table 1 is the only geographic control variable that has a statistically significant effect on bilateral market integration, as an additional control variable at the second stage. Conditional on the East-West bias from Table 1, we find that regional taste differences, predicted by past cultural proximity continue to have a somewhat smaller but highly significant negative effect on the integration of fruit and vegetable markets in Japan.

Table 3 for the largest part confirms the findings from table 2, with the main difference concerning Specifications (4) and (8) in which the IV estimates of taste dissimilarity on market integration are imprecisely estimated if bilateral market integration is captured by the cointegration of average market prices.

Throughout the Tables 2 and 3 we find that the IV estimates are consistently larger than the corresponding OLS estimates, which could be explained by the fact that the OLS estimates are biased towards zero in the presence of measurement error. When accounting for price and income effects in the measurement of tastes by using tastes estimates from an ideal demand system instead of expenditure shares to proxy for regional preferences the downward bias in the OLS estimates appears to be somewhat smaller.

6 Conclusion

In order to test the localized tastes hypothesis, this paper develops a novel identification strategy, which exploits the spatial variation in historical dialects from Japan to construct a measure of historical cultural proximity. Using historical cultural proximity among Japanese Markets as an instrument for the overlap in local preferences allows us to identify the negative impact that local taste differences have on the inter-regional integration of fruit and vegetable markets in Japan.

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A Appendix

Table A.1: *List of Commodities*

#	Commodity (English)	Commodity (Japanese)	Wholesale Market Survey	Family Income and Expenditure Survey	Broad commodity category
Fruits:					
1	apple	りんご	✓	✓	fruit
2	cherry	おうとう	✓	✗	–
3	chestnut	くり	✓	✗	–
4	grape	ぶどう	✓	✓	fruit
5	Japanese apricot	うめ	✓	✗	–
6	Japanese plum	すもも	✓	✗	–
7	kaki	かき	✓	✓	fruit
8	kiwi fruit	キウイフルーツ	✓	✓	fruit
9	loquat	びわ	✓	✗	–
10	miscellaneous citrus fruits	みかん	✓	✓	fruit
11	muskmelon	メロン	✓	✓	fruit

Continued on next page...

Table A.1: *List of Commodities (continued from previous page)*

#	Commodity (English)	Commodity (Japanese)	Wholesale Market Survey	Family Income and Expenditure Survey	Broad commodity category
12	nashi	なし	✓	✓	fruit
13	peach	もも	✓	✓	fruit
14	pear	西洋なし	✓	✗	–
15	Satsuma mandarin	蜜柑	✓	✗	–
16	strawberry	いちご	✓	✓	fruit
17	watermelon	すいか	✓	✓	fruit
Vegetables:					
1	asparagus	アスパラガス	✓	✗	–
2	bamboo shoot	たけのこ	✓	✓	vegetable (root)
3	bell pepper	ピーマン	✓	✓	vegetable (fruit)
4	bok choy	ちんげんさい	✓	✗	–
5	broad bean	そらまめ	✓	✗	–
6	broccoli	ブロッコリー	✓	✓	vegetable (leaf)
7	cabbage	キャベツ	✓	✓	vegetable (leaf)
8	carrot	にんじん	✓	✓	vegetable (root)
9	cauliflower	カリフラワー	✓	✗	–
10	celery	セルリー	✓	✗	–
11	cherry tomato	ミニトマト	✓	✗	–
12	cucumber	きゅうり	✓	✓	vegetable (fruit)
13	daikon radish	だいこん	✓	✓	vegetable (root)
14	eggplant	なす	✓	✓	vegetable (fruit)
15	enoki mushroom	えのきだけ	✓	✗	–
16	garland chrysanthemum	しゅんぎく	✓	✗	–
17	garlic	にんにく	✓	✗	–
18	garlic chives	にら	✓	✗	–
19	giant butterbur	ふき	✓	✗	–
20	ginger	しょうが	✓	✗	–
21	great burdock	ごぼう	✓	✓	vegetable (root)
22	green beans	さやいんげん	✓	✗	–
23	green peas	実えんどう	✓	✗	–
24	green soybeans	えだまめ	✓	✗	–
25	lettuce	レタス	✓	✓	vegetable (leaf)
26	lotus root	れんこん	✓	✓	vegetable (root)
27	mizuna	みずな	✓	✗	–
28	mustard spinach	こまつな	✓	✗	–
29	nameko mushroom	なめこ	✓	✗	–
30	napa cabbage	はくさい	✓	✓	vegetable (leaf)
31	onion	たまねぎ	✓	✓	vegetable (root)
32	parsley	パセリ	✓	✗	–
33	potato	ばれいしょ	✓	✓	vegetable (root)
34	pumpkin	かぼちゃ	✓	✓	vegetable (fruit)
35	sugar peas	さやえんどう	✓	✗	–
36	shiitake mushroom	生しいたけ	✓	✓	vegetable (fruit)
37	shimeji mushroom	しめじ	✓	✗	–

Continued on next page...

Table A.1: *List of Commodities (continued from previous page)*

#	Commodity (English)	Commodity (Japanese)	Wholesale Market Survey	Family Income and Expenditure Survey	Broad commodity category
38	small sweet green pepper	ししとうがらし	✓	✗	–
39	spikenard	うど	✓	✗	–
40	spinach	ほうれんそう	✓	✓	vegetable (leaf)
41	sweet corn	スイートコーン	✓	✗	–
42	sweet potato	かんしょ	✓	✓	vegetable (root)
43	taro	さといも	✓	✓	vegetable (root)
44	tomato	トマト	✓	✓	vegetable (fruit)
45	turnip	かぶ	✓	✗	–
46	welsh onion	ねぎ	✓	✓	vegetable (leaf)
47	wildparsley	みつば	✓	✗	-
48	yam	やまのいも	✓	✗	–

Notes: Table A.1 lists all 65 commodities covered by the Survey of Japanese Wholesale Markets for Fruits and Vegetables (MAFF) and all 31 commodities covered by the Japanese Family Income and Expenditure Survey (MIC) with their names (in English and Japanese). The 31 commodities from the Japanese Family Income and Expenditure Survey are classified into the following 4 broad goods categories: "fruit", "vegetable (root)", "vegetable (leaf)" and "vegetable (fruit)".

Table A.2: *List of Japanese Wholesale Markets for Fruits and vegetables*

						Average market integration	
#	**Market (English)**	**Market (Japanese)**	**Prefecture**	**City**	**Municipality**	**Price Volatility**	**Price Cointegration**
1	Sapporo City Wholesale Market	札幌市中央卸売市場	Hokkaido	Sapporo	Sapporo	0.1799	4.2222
2	Asahikawa City Fruits and Vegetables Market	旭川市青果市場	Hokkaido	Asahikawa	Asahikawa	0.1674	3.8315
3	Aomori City Wholesale Market	青森市中央卸売市場	Aomori	Aomori	Aomori	0.1878	5.4942
4	Hachinohe City Wholesale Market	八戸市中央卸売市場	Aomori	Hachinohe	Hachinohe	0.1565	3.7302
5	Morioka City Wholesale Market	盛岡市中央卸売市場	Iwate	Morioka	Morioka	0.1702	5.3889
6	Sendai City Wholesale Market	仙台市中央卸売市場	Miyagi	Sendai	Sendai	0.1583	4.4092
7	Akita City Fruits and Vegetables Market	秋田市青果市場	Akita	Akita	Akita	0.1583	4.0627
8	Yamagata City Fruits and Vegetables Market	山形市青果市場	Yamagata	Yamagata	Yamagata	0.2021	3.3897
9	Fukushima City Fruits and Vegetables Market	福島市青果市場	Fukushima	Fukushima	Fukushima	0.3108	6.0602
10	Iwaki City Wholesale Market	いわき市中央卸売市場	Fukushima	Iwaki	Hitachi	0.3172	4.8835
11	Mito City Fruits and Vegetables Market	水戸市青果市場	Ibaraki	Mito	Mito	0.1894	4.6778
12	Utsunomiya City Wholesale Market	宇都宮市中央卸売市場	Tochigi	Utsunomiya	Utsunomiya	0.1960	4.0903
13	Maebashi City Fruits and Vegetables Market	前橋市青果市場	Gunma	Maebashi	Maebashi	0.1794	4.4959
14	Saitama City Wholesale Market	大宮総合食品卸売市場	Saitama	Saitama	Saitama	0.1644	6.0430
15	Tokyo City JA-Center	ＪＡ全農東京センター	Saitama	Toda	Toda	0.2498	5.1396
16	Chiba City Fruits and Vegetables Market	千葉市青果市場	Chiba	Chiba	Chiba	0.2450	4.4737
17	Matsudo City Fruits and Vegetables Market	松戸市青果市場	Chiba	Matsudo	Matsudo	0.1889	3.9341
18	Tokyo Prefecture Tsukiji Wholesale Market	東京都中央築地市場	Tokyo	Tokyo	Tokyo	0.1595	3.5209
19	Tokyo Prefecture Ota Wholesale Market	東京都中央大田市場	Tokyo	Tokyo	Tokyo	0.1605	3.6153
20	Tokyo Prefecture Kita-Adachi Wholesale Market	東京都中央北足立市場	Tokyo	Tokyo	Tokyo	0.1692	3.9621
21	Tokyo Prefecture Kasai Wholesale Market	東京都中央葛西市場	Tokyo	Tokyo	Tokyo	0.1745	4.0042
22	Tokyo Prefecture Toshima Wholesale Market	東京都中央豊島市場	Tokyo	Tokyo	Tokyo	0.1775	4.5578
23	Tokyo Prefecture Yodobashi Wholesale Market	東京都中央淀橋市場	Tokyo	Tokyo	Tokyo	0.1776	4.3358
24	Tokyo Prefecture Setagaya Wholesale Market	東京都中央世田谷市場	Tokyo	Tokyo	Tokyo	0.1843	4.6592
25	Tokyo Prefecture Itabashi Wholesale Market	東京都中央板橋市場	Tokyo	Tokyo	Tokyo	0.1827	4.6694
26	Tokyo Prefecture Tama Wholesale Market	東京都中央多摩市場	Tokyo	Tama	Tama	0.3911	3.4317

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Table A.2: *List of Japanese Wholesale Markets for Fruits and vegetables (continued from previous page)*

						Average market integration	
#	Market (English)	Market (Japanese)	Prefecture	City	Municipality	Price Volatility	Price Cointegration
27	Yokohama City Central Wholesale Market	横浜市中央市場本場	Kanagawa	Yokohama	Yokohama	0.1558	4.9669
28	Kawasaki City Wholesale Market	川崎市中央卸売市場	Kanagawa	Kawasaki	Kawasaki	0.1806	5.3354
29	Kanagawa Prefecture JA-Center	ＪＡ全農神奈川センター	Kanagawa	Hiratsuka	Hiratsuka	0.1905	4.3673
30	Niigata City Wholesale Market	新潟市中央卸売市場	Niigata	Niigata	Niigata	0.2115	4.1331
31	Toyama City Fruit and Wholesale Market	富山市青果市場	Toyama	Toyama	Toyama	0.2082	4.4495
32	Kanazawa City Wholesale Market	金沢市中央卸売市場	Ishikawa	Kanazawa	Kanazawa	0.1951	5.2222
33	Fukui City Wholesale Market	福井市中央卸売市場	Fukui	Fukui	Fukui	0.2246	5.2164
34	Kofu City Fruits and Vegetables Market	甲府市青果市場	Yamanashi	Kofu	Kofu	0.2192	4.2063
35	Nagano City Fruits and Vegetables Market	長野市青果市場	Nagano	Nagano	Nagano	0.1871	4.5602
36	Matsumoto City Fruits and Vegetables Market	松本市青果市場	Nagano	Matsumoto	Matsumoto	0.1755	4.1611
37	Gifu City Wholesale Market	岐阜市中央卸売市場	Gifu	Gifu	Gifu	0.1539	4.5531
38	Shizuoka City Wholesale Market	静岡市中央卸売市場	Shizuoka	Shizuoka	Shizuoka	0.1887	5.0113
39	Hamamatsu City Wholesale Market	浜松市中央卸売市場	Shizuoka	Hamamatsu	Hanamatsu	0.1658	4.3362
40	Nagoya City Central Wholesale Market	名古屋市中央市場本場	Aichi	Nagoya	Nagoya	0.1534	3.8236
41	Nagano City Northern Wholesale Market	名古屋市中央市場北部	Aichi	Nagoya	Nagoya	0.1672	3.9108
42	Mie Prefecture Fruits and Vegetables Market	三重県青果市場	Mie	Matsusaka	Matsusaka	0.2383	4.7231
43	Otsu City Fruits and Vegetables Market	大津市青果市場	Shiga	Otsu	Otsu	0.1962	4.9013
44	Kyoto City Wholesale Market	京都市中央卸売市場	Kyoto	Kyoto	Kyoto	0.1597	4.3474
45	Osaka City Central Wholesale Market	大阪市中央市場本場	Osaka	Osaka	Osaka	0.2105	4.3707
46	Osaka City Eastern Wholesale Market	大阪市中央市場東部	Osaka	Osaka	Osaka	0.2113	4.4488
47	Osaka Prefecture Wholesale Market	大阪府中央卸売市場	Osaka	Ibaraki	Ibaraki	0.2316	5.3303
48	Osaka City JA-Center	ＪＡ全農大阪センター	Osaka	Takatsuki	Takatsuki	0.1885	4.6326
49	Kobe City Central Wholesale Market	神戸市中央市場本場	Hyogo	Kobe	Kobe	0.1774	4.3504
50	Kobe City Eastern Wholesale Market	神戸市中央市場東部	Hyogo	Kobe	Kobe	0.2898	4.8030
51	Nara Prefecture Wholesale Market	奈良県中央卸売市場	Nara	Nara	Nara	0.2160	4.4748
52	Wakayama City Wholesale Market	和歌山市中央卸売市場	Wakayama	Wakayama	Wakayama	0.1983	4.7626

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Table A.2: *List of Japanese Wholesale Markets for Fruits and vegetables (continued from previous page)*

						Average market integration	
#	**Market (English)**	**Market (Japanese)**	**Prefecture**	**City**	**Municipality**	**Price Volatility**	**Price Cointegration**
53	Tottori City Fruits and Vegetables Market	鳥取市青果市場	Tottori	Tottori	Tottori	0.2061	5.5237
54	Matsue City Fruits and Vegetables Market	松江市青果市場	Shimane	Matsue	Matsue	0.2653	5.4775
55	Okayama City Wholesale Market	岡山市中央卸売市場	Okayama	Okayama	Okayama	0.3594	5.9876
56	Hiroshima City Central Wholesale Market	広島市中央市場中央	Hiroshima	Hiroshima	Hiroshima	0.2697	6.8287
57	Hiroshima City Eastern Wholesale Market	広島市中央市場東部	Hiroshima	Hiroshima	Hiroshima	0.2083	5.0568
58	Fukuyama City Fruits and Vegetables Market	福山市青果市場	Hiroshima	Fukuyama	Fukuyama	0.2075	4.8039
59	Ube City Wholesale Market	宇部市中央卸売市場	Yamaguchi	Ube	Ube	0.1877	3.9525
60	Tokushima City Wholesale Market	徳島市中央卸売市場	Tokushima	Tokushima	Tokushima	0.1673	4.6672
61	Takamatsu City Wholesale Market	高松市中央卸売市場	Kagawa	Takamatsu	Takamatsu	0.1847	4.7098
62	Matsuyama City Wholesale Market	松山市中央卸売市場	Ehime	Matsuyama	Matsuyama	0.1941	4.9675
63	Kochi City Wholesale Market	高知市中央卸売市場	Kochi	Kochi	Kochi	0.1728	4.2837
64	Kitakyushu City Wholesale Market	北九州市中央卸売市場	Fukuoka	Kitakyushu	Kitakyushu	0.2021	4.6310
65	Fukuoka City Wholesale Market	福岡市中央卸売市場	Fukuoka	Fukuoka	Fukuoka	0.2174	4.8282
66	Kurume City Wholesale Market	久留米市中央卸売市場	Fukuoka	Kurume	Kurume	0.1948	4.9887
67	Saga City Fruits and Vegetables Market	佐賀市青果市場	Saga	Saga	Saga	0.2026	4.4197
68	Nagasaki City Wholesale Market	長崎市中央卸売市場	Nagasaki	Nagasaki	Nagasaki	0.1863	3.7522
69	Kumamoto City Fruits and Vegetables Market	熊本青果市場	Kumamoto	Kumamoto	Kumamoto	0.1977	3.9216
70	Oita City Fruits and Vegetables Market	大分市青果市場	Oita	Oita	Oita	0.1826	4.4903
71	Miyazaki City Wholesale Market	宮崎市中央卸売市場	Miyazaki	Miyazaki	Miyazaki	0.2196	4.7228
72	Kagoshima City Wholesale Market	鹿児島市中央卸売市場	Kagoshima	Kagoshima	Kagoshima	0.1661	4.3853

Notes: Table A.2 list 72 wholesale markets for fruits and vegetables with their names (in English and Japanese) and their location (i.e. prefecture and city). To match the Survey of Japanese Wholesale Markets for Fruits and Vegetables to the Japanese Family Income and Expenditure Survey each wholesale market is associated with the geographically closest municipality from the Japanese Family Income and Expenditure Survey. For each wholesale market the average level of market integration is computed as an unweighted mean of bilateral market integration with all other partner markets based on the 65 commodities covered by the Survey of Japanese Wholesale Markets for Fruits and Vegetables and the 31 commodities covered by the Japanese Family Income and Expenditure Survey.

Figure A.1: *Wholesale Markets, Prefectures, Regions and East-versus-West Japan*

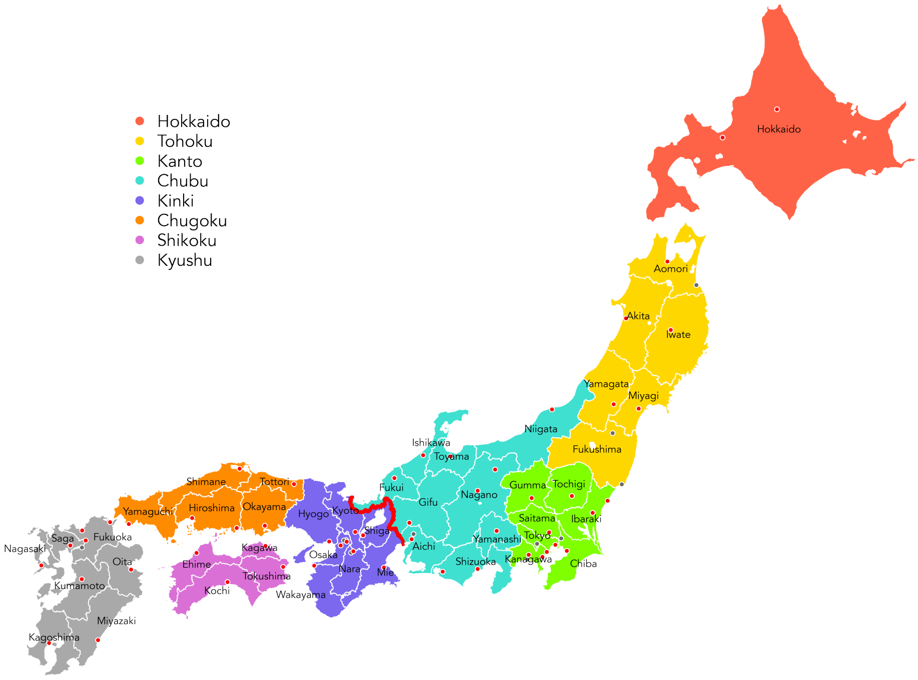

Table A.3: *Questions and Maps from the Linguistic Atlas of Japan*

Included questions (identified by their number)
001, 002, 00, 004, 005, 006, 007, 008, 009, 010, 011, 012, 013, 014, 015, 016, 017, 018, 019, 021, 022, 023, 026, 028, 030, 031, 032, 033, 034, 035, 036, 037, 038, 039, 040, 041, 042, 043, 044, 045, 046, 047, 048, 049, 050, 051, 052, 053, 054, 055, 056, 057, 058, 059, 060, 061, 063, 064, 065, 066, 067, 068, 069, 070, 071, 072, 073, 074, 075, 076, 079, 080, 081, 082, 083, 084, 085, 086, 087, 088, 089, 090, 091, 092, 093, 094, 095, 096, 097, 099, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 142, 143, 144, 146, 147, 148, 149, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 171, 172, 173, 174, 175, 176, 177, 178, 179, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 204, 206, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 247, 248, 249, 250, 251, 252, 253, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 268, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284
Included maps (identified by their number)
1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 121, 122, 123, 124, 125, 127, 128, 129, 130, 131, 132, 133, 134, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 291, 293, 294, 296, 297, 298, 299, 300