Risk and Return in Roman Egypt

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Agenda

- Introduction
- Underlying Research Questions
- Methodology
- Analysis of Market Characteristics
- Risk and Return Hierarchy
- Modelling Financial Risks for Farming Families
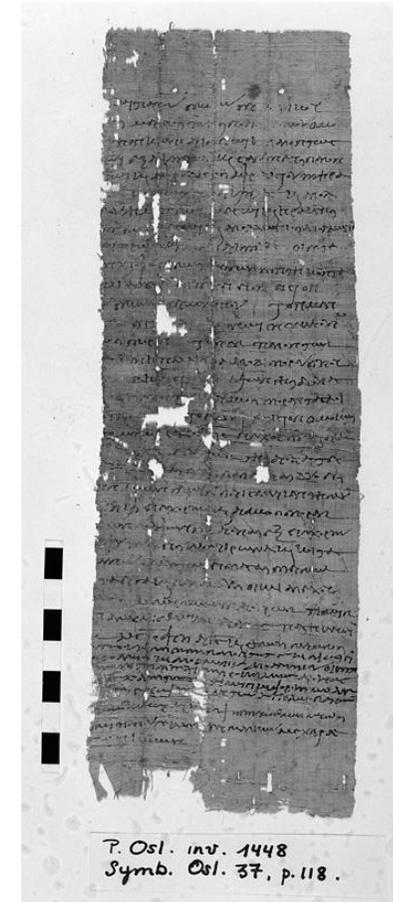- Overall Conclusions

Introduction

- Papyri from Roman Egypt

- c. 20,000 documentary sources from AD 1 to 350, contracts, official documents, receipts, letters ….

- Generally poorly attributed from an archaeological perspective but found in variety of contexts:
  - Houses
  - Rubbish dumps
  - Used as stuffing for mummified sacred crocodiles…

- 4,367 financial transactions involving 9,700+ individuals

- These are the records of ordinary people who worked the land or lived in small cities
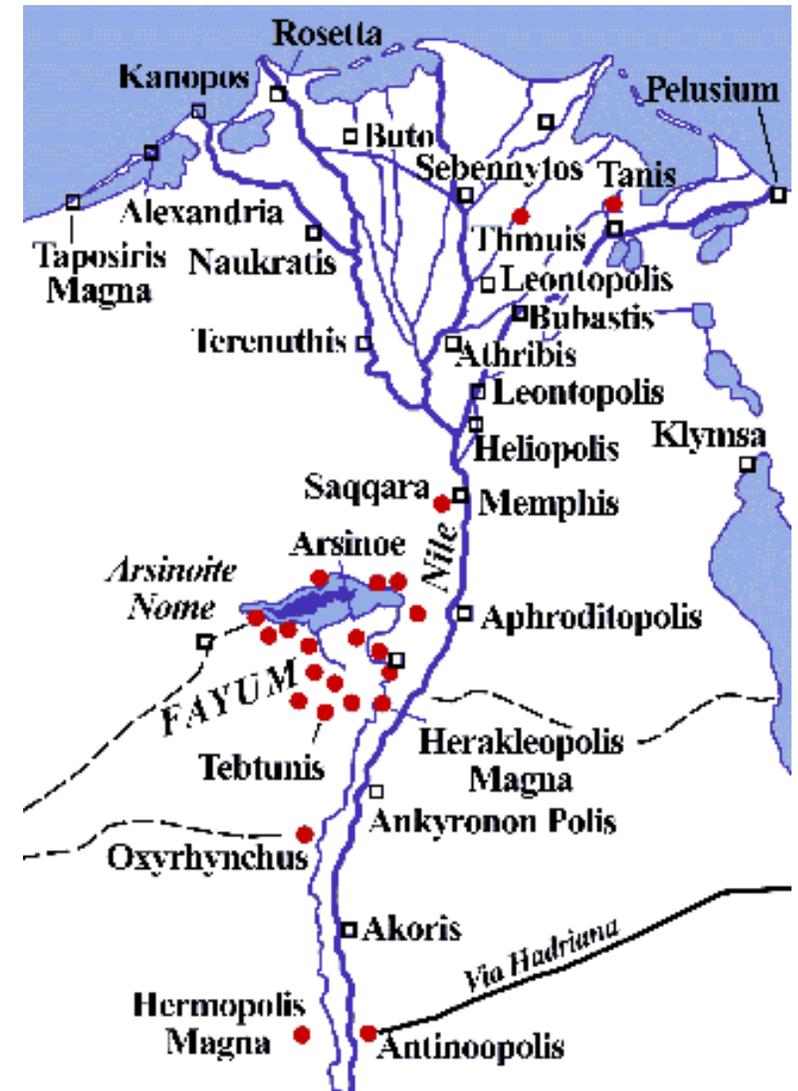
Map after Baines and Malek: 1980

Example Document: *SB* VIII 9830 – Lease of Land dated to AD 84-96

- [ἔτους .̣.̣ Αὐτοκράτορος Καίσαρος
Δο]μιτιανοῦ Σεβαστοῦ Γερμανικοῦ
[Μεχεὶρ α ἐν Τεπτύνει τῆς Πολέμων(?)]ος
μερίδος τοῦ Ἀρσινοείτου νομοῦ. ὁμο-
[λογοῦσι Θέων Πάτρωνος ὡς ἐτῶν .̣.̣ ο]ὐλὴ
ἀνκῶνι ἀριστερῶι καὶ Παποντῶς
[τοῦ δεῖνα ὡς ἐτῶν μς οὐλὴ μετώ]πωι ἐξ
ἀριστερᾶς καὶ Σανσνεὺς Παπον-
5[τῶτος ὡς ἐτῶν .̣.̣ οὐλη(?) ἀριστ]ερῶι καὶ
Ἀφροδίσιος Ἀφροδισίου, τοῦ Ἡρα-
[κλ -ca.?- ὡς ἐτῶν .̣.̣ οὐλὴ δακτ]ὐ[λω]ι μέσωι
χειρὸς ἀριστερᾶς καὶ Ἀπολ-
[λώνιος(?) Ἀπολλωνίου ὡς ἐτῶν] Traces οὐλὴ
μετώπωι μέσωι καὶ Ἡρακλῆς
[Πτολεμαίου ὡς ἐτῶν .̣.̣ οὐλὴ] μετώπωι
μέσωι καὶ Ἀπολλώνιος Ἀπολλωνί-
[ου ὡς ἐτῶν .̣.̣ οὐλὴ δακτύλ]ωι πρώτωι
χειρὸς ἀριστερᾶς οἱ ἑπτὰ
10[γεωργοῦντες δημοσίων ἐδαφῶν.....

P. Osl. inv. 1448
Symb. Osl. 37, p. 118.

Photo: Photographic Archive of Papyri in the Cairo Museum

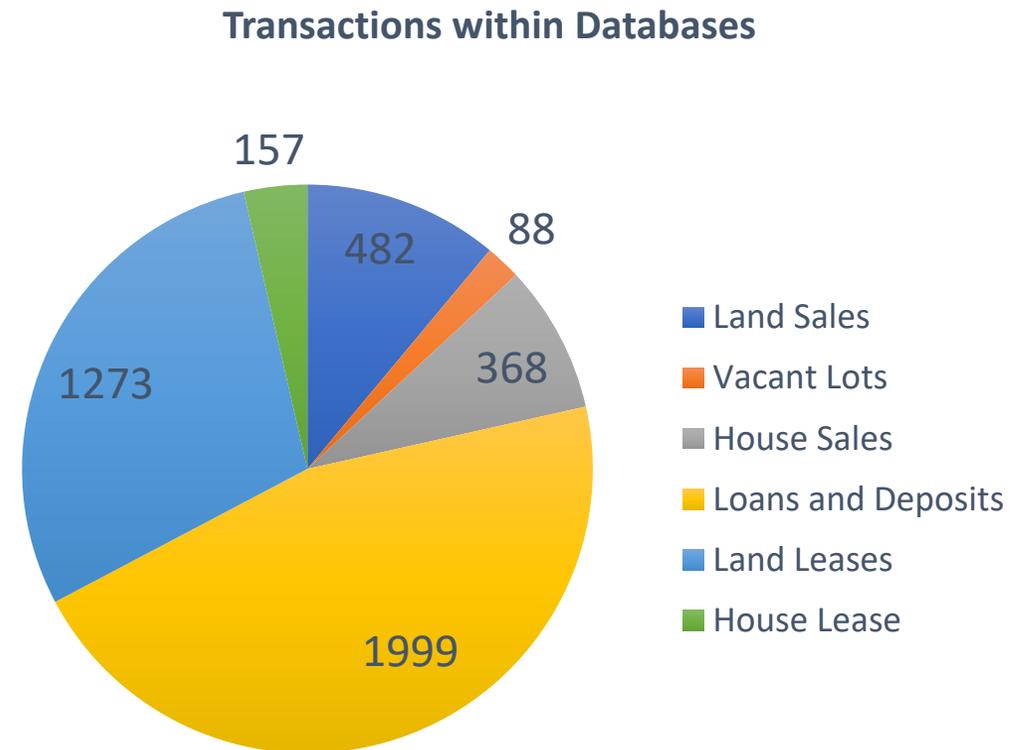# Underlying Research Questions

- What were
  - The natures of the financial markets of Roman Egypt?
  - Financial risks for farming families in Roman Egypt?

Methodology

- Models – 'Some of the greatest fun I have had in Roman history has been in constructing models…models allow us to perceive the structures or repeated patterns which lie behind the superficial flow of individual actors and events…models allow us to construct whole pictures' – Hopkins.

- Roman Egypt has the necessary background data to allow plausible modelling and the time period AD 50 to 150 is chosen to cover period of relative price, climate(?) and social stability.

- Microeconomic analysis looking at individual transactions and family scenarios to provide wider information on society.

Databases of Financial Transactions

- 6 inter-connected databases

- Information on terms, parties, sizes etc gathered

- 4,367 transactions in total

Transactions within Databases

- Land Sales
- Vacant Lots
- House Sales
- Loans and Deposits
- Land Leases
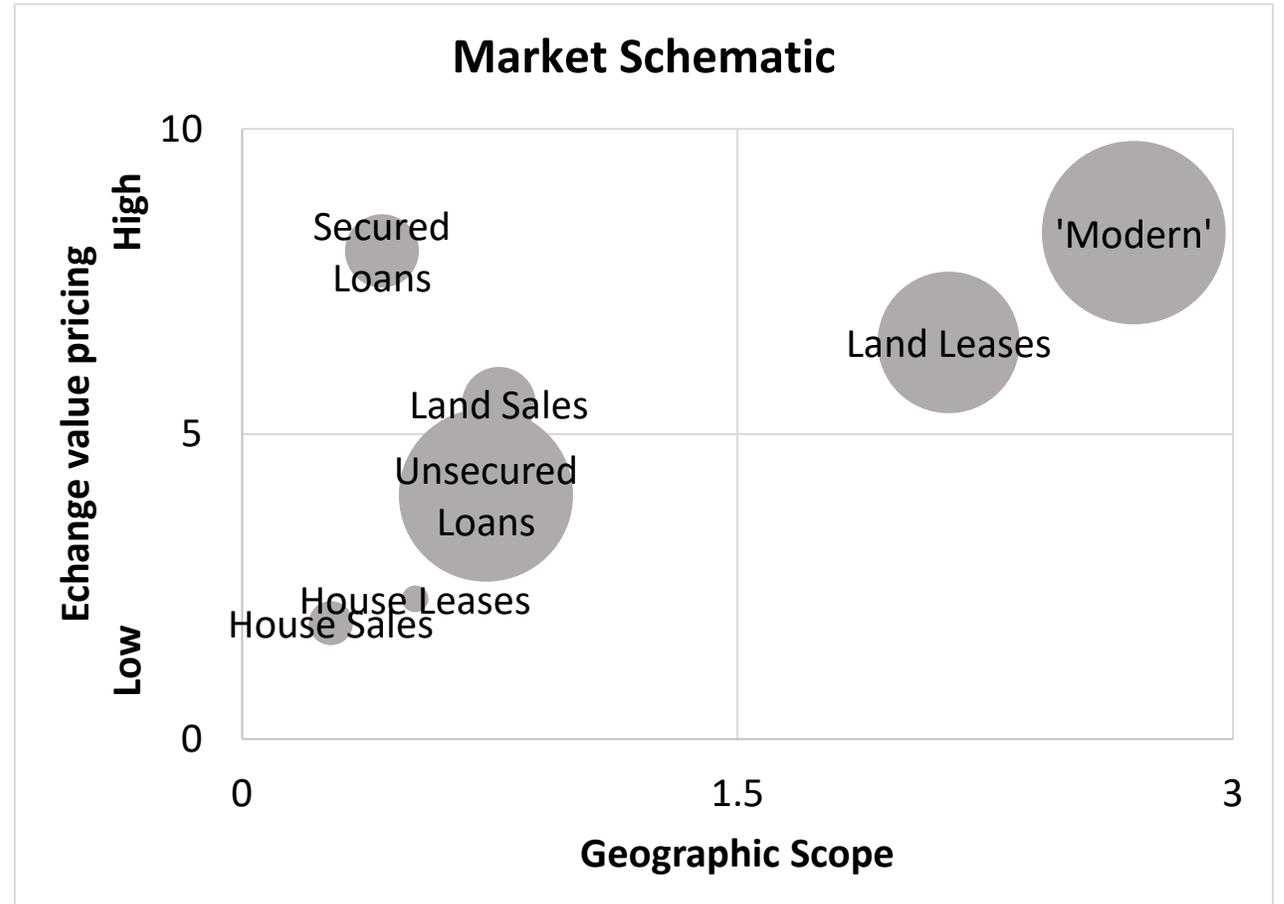- House Lease

482
88
368
1999
1273
157

Analysis of Market Characteristics

- Can define three (or more) dimensions to understand market:
  - Liquidity – need transactions to be relatively frequent to allow pricing mechanisms to develop – an illiquid market unlikely to be efficient
    - Total monetary amount of transactions is a good guide to liquidity
  - Pricing – are markets driven by exchange value rather than state action or conventional pricing?
    - Price rounding or variability are good indicators of degree of exchange value or conventional pricing
  - Geographic scope – most efficient markets are those where market is inter-connected to other geographies allowing greater demand/supply interaction
    - Localisation ratio of network provides a good proxy for geographic integration
- Each market exhibits different features.

Market Schematic

- Liquidity is represented by the size of the circles (objective)
- Exchange value pricing determined by rounding and variability (subjective but based on objective variables)
- Geographic scope is localisation ratio (objective)
- In general, large circles in the upper right quadrant, could be regarded as exchange value-driven liquid integrated markets. Small circles in the lower left quadrant would suggest convention-driven, illiquid local markets

Market Schematic

Echange value pricing

High

Low

10

5

0

Secured Loans

Land Sales

Unsecured Loans

House Leases

House Sales

Land Leases

'Modern'

0

1.5

3

Geographic Scope

Risk and Return Hierarchy
Options for investors – modelling

- Direct farming of land

- *Leasing of land – 105 individual leases*

- Housing for rent

- *Secured cash loans – 67 individual loans where interest rate and capital known*

- *Unsecured cash loans – 66 individual loans where interest rate and capital known*

- *Commodity loans - 27 individual loans where interest rate known*

- Trade and manufacture

Risk and Return Hierarchy
How to calculate investment return achieved?

- Analyse *individual* transactions to determine return which is

r = Profit divided by Capital employed

Profit = Income less frictional costs less taxation less depreciation/ maintenance

- Previous attempts, e.g. Carrié, have been based on single number or range estimates.

Allowing for risk

- Assessing return without risk is misleading.
- Secured loan returns still have some residual risk of debtor default, in which case lender could seize assets, which might even be of higher value than debt so make profit after costs
- Return from unsecured loans or land rental has however, considerable risks:
  - Harvest failure or other risk leading to default or reduced rent
  - Cash value of cereals received as rent or repayment will fluctuate
- And risks are inter-related – in good years when rent received in full, prices probably low, since best prices available in years when harvest fails
- Requires a stochastic approach to model risks with series of Monte-Carlo simulations
  - Value of cereals is inversely correlated with success of Nile flood
  - Since emphasis on capital values not price – have not allowed for land price volatility
- Make 1,000 simulations of financial return for each transaction to establish range of possible outcomes for this transaction
- Combine all simulations to arrive at likely distribution of returns

Risk and Return results

Stochastic Return Distributions
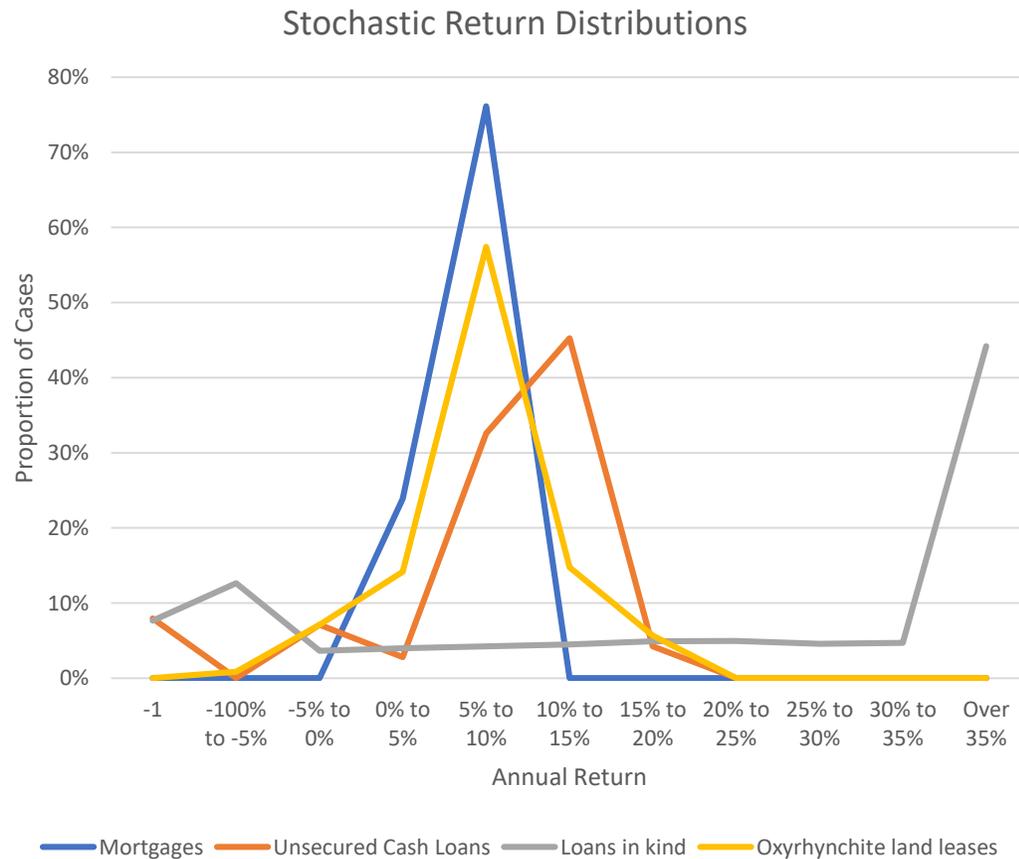
Return p.a.	Median	Average
Mortgages	8%	7%
Unsecured Cash Loans	10%	0%
Loans in kind	29%	24%
Oxyrhynchite Land leases	7%	7%

Risk and Return Hierarchy
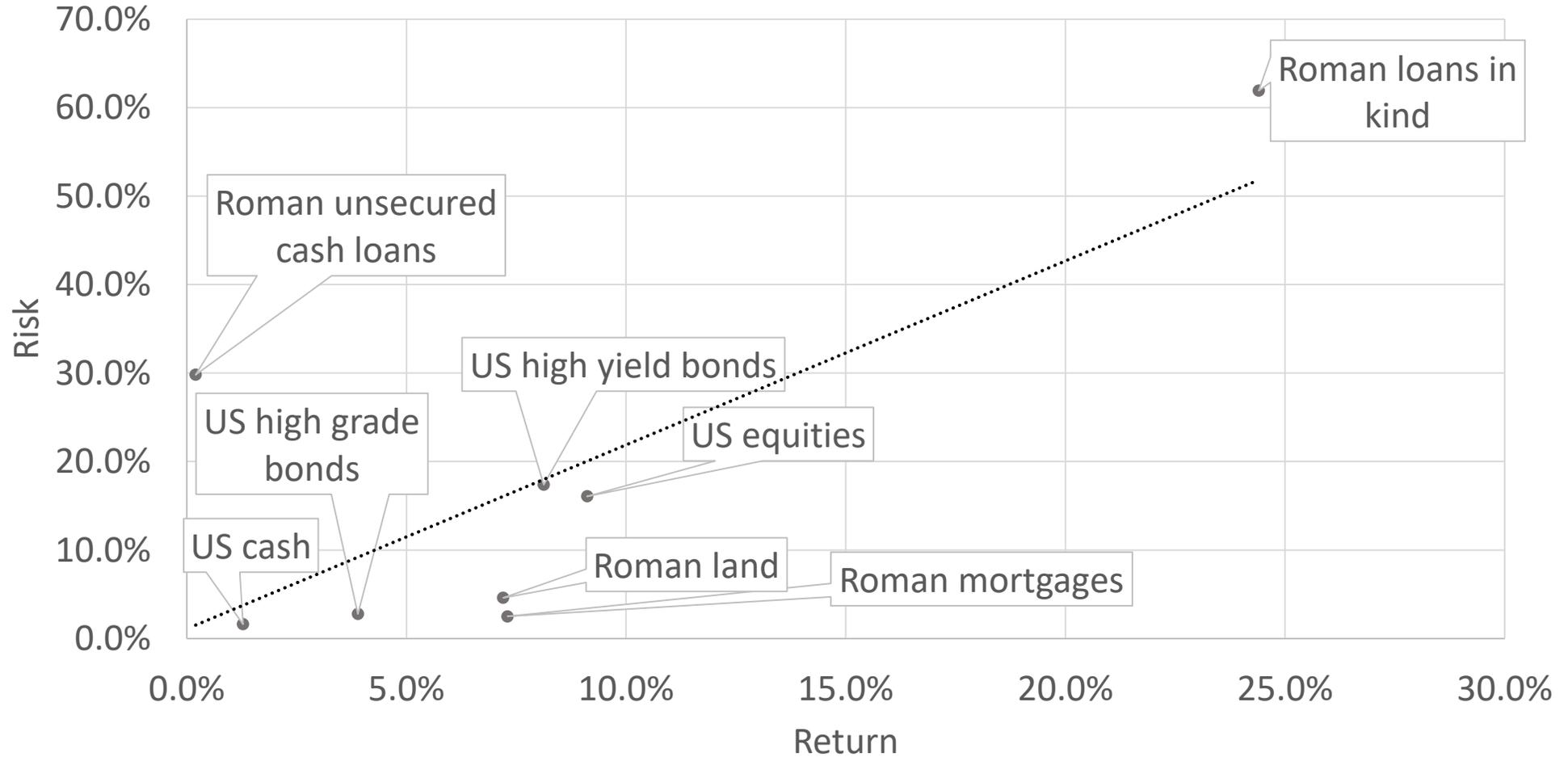
Conclusions – Nature of the Markets

- Cannot talk of a 'single' Roman market economy or bazaar
- No evidence for financial rationality in housing market
- Unsecured cash loans seem to be driven by reciprocity/redistribution rather than exchange value
- Loans in kind equivalent to betting on volatile event
- But pre-requisites exist, and evidence for, exchange value driven markets in land and secured lending given logical risk/return hierarchy and other features.

Modelling Financial Risks for Farming Families

Base Data

- Newly married couple, male 22, female 15, initially no other dependents. Within wider family. Tenants, Smallholders, 'petty' landlords.

- Follow their income and savings over 15 years

- Initial savings for each, the same, assumed to be enough wheat and money for seed and subsistence until harvest

- Tenant families have land holding sufficient to provide c.20% surplus income over subsistence in typical years. Same land size assumed for smallholders, petty landowners assumed to farm same land size themselves and rent out same amount to others.

- Key assumptions:
  - Year on Year harvest variability: 20%
  - Wheat yield 12.8:1
  - Fallow 50%
  - Spoilage: 5%
  - Yearly chance of Nile flood failure: 8%.

Micro-Econometric Model

- Essentially model net income (wheat and cash) after taxes and costs.
  - And outgo which is subsistence for family plus discretionary spend.
    - Savings/Debt at end of year is that at start plus income less outgo.
- Balance between cash and wheat rebalanced at year end at prevalent wheat price to eliminate deficits where possible – if balance is still negative then borrow.
- Savings assumed to be invested in agricultural sector through purchase/leasing of land.
- Assume those in need prefer to borrow rather than sell land.
- Debt assumed to attract interest, savings gains return.
- Look to see which families prosper, fall into debt and who are ruined over a generation. Ruin defined as point where impossible to service existing debt from likely income.

Results - Plausible and Sustainable

Demographically sustainable
Peasant debt endemic
Typical predicted borrowing consistent with later Egyptian evidence
Those ruined balanced by those who prosper

Percentage of families at end of 15 years experiencing event				
	Ruined	New-borns abandoned	Fallen into debt	Doubling initial wealth
Petty Landowner	0%	NA	2%	11%
Smallholder	2%	NA	16%	8%
Tenant	4%	6%	34%	38%

Tenants most at risk

Tenant savings/debt at end of generation
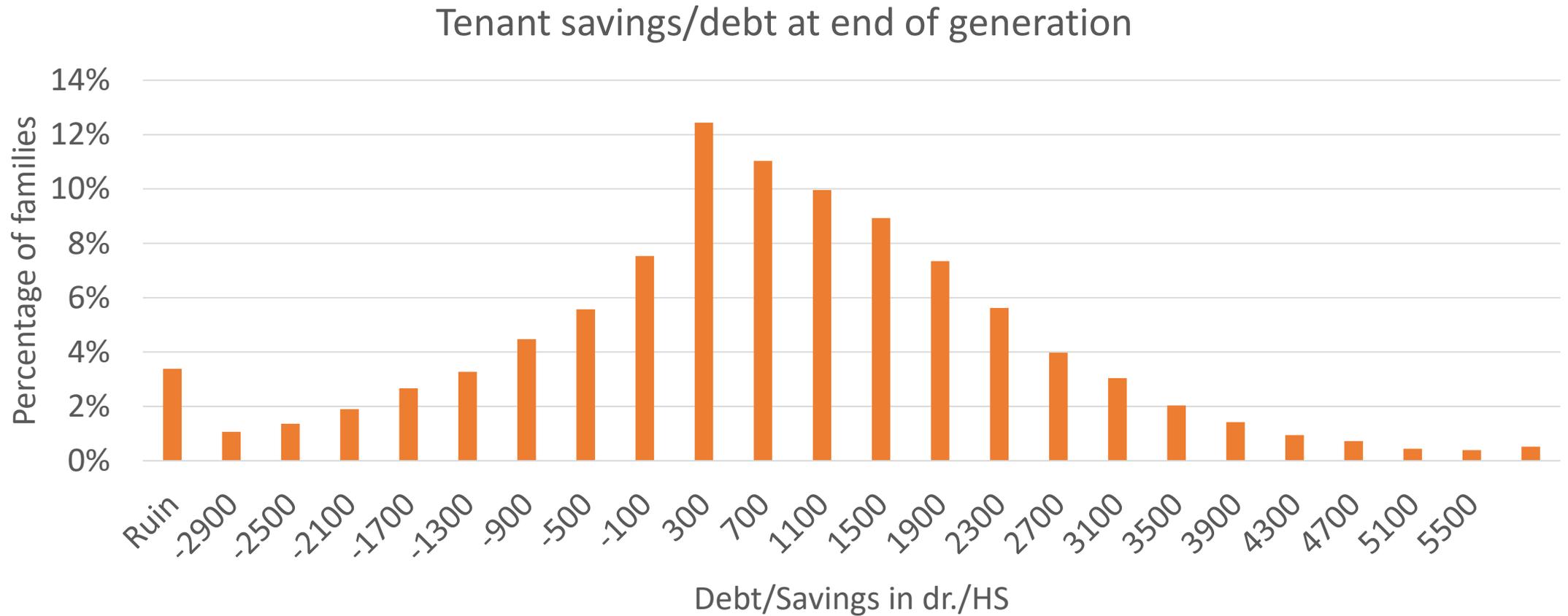
Climate risk - Tenants

Tenant Ruin probability – as function of harvest variability

Harvest Variability	15%	20%	25%	30%	35%
Ruin Probability	2%	4%	9%	17%	26%

Tenant Ruin probability – as function of spoilage

Spoilage Rate	5%	10%	15%
Ruin Probability	4%	5%	7%

Tenants very exposed to harvest variability, less so to spoilage.

Fertility risk – too many mouths? – Tenants

- Less important than climate. If run model with no family size variability – still a significant chance of tenant ruin. If run model with no harvest variability – chance of tenant ruin falls essentially to zero.

- But significant linkage between family size and debt levels:

Number of children surviving	0	1	2	3	4	5	6+
Chance of being in debt after 15 years	15%	20%	28%	36%	44%	56%	67%

Spending and Saving – Tenants

- Model assumes that discretionary spend is normally distributed around 50% of available income. What if we assume higher/lower spending/saving?:

Discretionary Spend	0%	30%	50%	70%	100%
Chance of ruin	1%	2%	4%	9%	28%

- Saving of a significant proportion of disposable income was a requirement to ensure survival, but no matter how prudent families were, there was still a chance that they would face ruin as a result of successive poor harvests.

Overall Conclusions

- Roman world was capable of efficient market economy
- But not all financial sectors of economy were so driven, most activity 'embedded' in society
- Land ownership key to financial security
- Debt endemic
- Financial ruin dependent on fertility and savings habits, but climate variability and impact on harvest the key driver
- Few opportunities for social mobility for most farming families

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