1-1-2019

Essays On Money And Labor

Kwabena Okyere Boateng

ESSAYS ON MONEY AND LABOR

A Dissertation

presented in partial fulfilment of requirements

for the Degree of Doctor of Philosophy

in the Department of Economics

The University of Mississippi

by

Kwabena Okyere Boateng

December, 2019

Abstract

The price-specie-flow mechanism (PSFM) is a theory of the adjustment of the balance of trade and gold flows as a result of deviations in relative prices across countries under a gold standard. The PSFM is central to quantity-theoretic discussions of economic fluctuations under a gold standard as well as analysis of whether central banks followed “the rules of the game” of the gold standard. In short, the PSFM is the standard working assumption when it comes to gold standard adjustment. However, at least since Adam Smith there has been an alternative to the PSFM that has come to be known as the monetary approach to the balance of payments. The distinction between the PSFM and the monetary approach have important implications for both quantity-theoretic explanations of economic fluctuations as well as the interpretation of the so-called "rules of the game." In the first chapter, I outline and test the empirical predictions of each theory to determine which is more accurate. The evidence is mixed, but largely favors the monetary approach to the balance of payments.

In the second chapter, I use the national level skill group framework pioneered by Borjas (2003) to estimate the impact of immigration on the wages and the employment rates of native men and women separately. I find that a 10% increase in immigrant labor supply depresses wages of native women by about 3.5 percentage points but does not have a significant effect on the wages of native men. In exploring the possible explanations for the differences in wage impacts, I find that human capital differences could account for a large portion of these differences. There is not much support for blanket discrimination against immigrants and native women as a group, but the result could still be consistent with a more detailed discrimination story.

Dedication

To my mom - Veronica

Acknowledgements

My utmost gratitude goes to Dr. Josh Hendrickson, the chair of my dissertation committee for everything he taught me, his constant availability and generosity. I am very grateful for Dr. Ryan Gardner - exactly the kind of faculty member every graduate student needs. I count myself lucky to have worked with him. I thank Dr. Andre Liebenberg for his insight and constant encouragement. I am grateful for Dr. Jon Moen's insight and availability. I thank Dr. Walt Mayer, who taught me a lot and showed much support until his retirement. I also appreciate the support and kindness of the entire faculty and graduate student body at the Economics Department. I thank the University of Mississippi graduate school for providing funding for my dissertation and conferences.

My family, which comprises my mother - Veronica Arthur, my late father - Alex Boateng and my sister - Otubea Boateng have provided constant support and motivation for which I am immensely grateful. I made some friends along the way who became family and a true support system. I am thankful for friends such as Jomiloju Adebolu, Kenechukwu Okoye, Bright Osei, Conrad Puozaa, Enoch Sackey, Adedapo Adeniyi, Feng Liu and Joey White.

Contents

List of Figures

List of Tables

Chapter 1

Balance of Payments in a Commodity Standard

1.1 Introduction

1.1.1 Commodity Money Standard

A commodity money system is essentially a monetary system in which currency can be readily exchanged for a commodity at a fixed rate. For instance, between 1834 and 1933, a dollar bill was worth $1/20.67$ of an ounce of gold, and so the United States (US) was on a commodity standard, with gold as the commodity. Commodity standards have taken various forms throughout history, but for the purposes of this study, we restrict ourselves to what is commonly referred to as the classical gold standard. This will depict the period from 1873 to 1913, when a number of countries worldwide were on a gold standard. Every participating country declared its domestic currency in terms of a certain amount of gold, which created a fixed exchange rate system amongst countries on the gold standard.

The classical gold standard is widely regarded as a very successful monetary system. The era was a period of economic stability characterized by low inflation, rapid economic growth, free international trade and even political stability. Between 1879 and 1913, real income grew

by a factor of 3 and real income per capita increased by about two-thirds in the US. In the UK, during the same period, real income doubled and real income per capita increased by half (Friedman & Schwartz, 1982). Considering output stability, real per capita income in the US deviated from trend by an average of 6.64% between 1879 and 1913, compared to a deviation of 8.97% between 1919 and 1979 (excluding the World War II period). In the UK, the deviations were 2.14% from 1879-1913 and 3.75% from 1919-1979 (Bordo et al., 1981). Even when different measures of the price level are used and both World Wars are left out of the data, Bordo et al. (1981) still comes to the conclusion that the classical gold standard period produced more long-run price stability than any other currency regime, at least until 1979, when the study ends.

Due to the desirable economic features that accompanied the classical gold standard, some economists have called for a return to some version of this system. Some see it as a panacea for the problems of the current monetary system, especially the global inflation that has prevailed ever since the classical gold standard era ended. Proponents of free banking (e.g. Thompson, 1982, Glasner, 1989 and Selgin, 1988) allude to this era as exemplifying the smooth operation that comes with a competitive money supply system. However, to even begin a debate about the practicality of these proposals and have a sense of how such a system is going to work, we need to know how the classical gold standard operated.

1.1.2 Adjustment Mechanism Under a Gold Standard

Two contrasting theories exist on how adjustment of the balance of payments occurs in a commodity standard. The adjustment mechanism is considered from an open economy perspective since the gold standard extended beyond a single country. The more conventional theory is the price-specie-flow-mechanism (PSFM), which is widely attributed to Hume (1752). According to this view, changes in the relative price of domestic goods result in changes in the trade balance that must be resolved through the flow of gold between countries. The mechanism is as follows: Suppose that all countries initially have balanced trade. An increase in the domestic money supply causes domestic prices to rise. The increase in domestic prices relative to world prices

leads to a reduction in exports and an increase in imports, because imports become cheaper. Gold flows out of the domestic country to pay for these imports. In order to maintain the convertibility ratio between gold and the domestic currency, the gold outflow requires that the domestic money supply declines and the money supply in the exporting country increases. This process continues until prices in different countries normalize. According to this view, the chain of causation runs from the domestic money supply to the price level to the balance of trade.

The alternative theory, usually referred to as the monetary approach (McCloskey & Zecher, 1976; Johnson & Frenkel, 1976; Craig et al., 1995) has origins in Adam Smith (1776). According to the monetary approach, international arbitrage ensures that the real price of gold must be constant across countries. Also, fluctuations in the domestic price level are not caused by corresponding fluctuations in the domestic money supply. In other words, the quantity theory does not apply here. Since the nominal price of gold is fixed, changes in the demand or supply of gold causes changes only in the price level of other goods and not the nominal price of gold. So the price level in each country must adjust to clear the gold market. As a result, prices and interest rates are determined through international arbitrage. Money demand is determined taking the price level and interest rates as given and the broad money supply adjusts to money demand. If the domestic money supply is not sufficient to meet money demand, then the domestic country must import money (in currency and/or gold) to meet this insufficiency. This net import of money must be offset by a net export of goods and/or capital. Thus, according to the monetary approach, the chain of causation runs from change in the world price level, which results in a corresponding change in domestic prices and money demand. If the domestic money supply does not adjust to the change in money demand, then this gap is filled internationally and goods and capital markets must adjust accordingly. Otherwise, no international adjustment is necessary.

1.1.3 Relevance of Study

As discussed in subsection 1.1.1, ascertaining the true workings of the gold standard is essential if we want to examine suggestions about adopting such a standard. Adjustment under the gold standard is also relevant in the context of macroeconomic thought. Theories about events such as the Great Depression, which occurred under a gold standard, derive from assumptions about the adjustment mechanism in that regime. For instance, Friedman and Schwartz (1963)'s assessment of the Great Depression mostly assumes the PSFM as the adjustment mechanism; and so focuses on the local rather than global causes of the Depression. Alternative explanations that stress the importance of the relative price of gold, such as Warren and Pearson (1935), Thompson (1974), Glasner (1989), and Sumner (2015), implicitly imply that the PSFM is incorrect and are consistent with the monetary approach.

This study is also relevant for the "rules of the game" literature. Under the international gold standard, countries into which gold flowed were expected to increase their money supply whilst countries experiencing gold outflows were expected to decrease their money supply, all in order to expedite the balance of payment adjustment. This requirement was known as the *rules of the game*. The *rules of the game* only works if adjustment happens through the PSFM. In the monetary approach to the balance of payments, no such rules are necessary. Domestic monetary imbalances are worked out through the balance of payments. There is no need for deliberate international coordination. As Bordo and MacDonald (1997) detail, there seems to be a regular pattern of deviating from these rules by central banks during that era. Bordo and MacDonald suggest that gold points create an exchange rate band that gave central banks some flexibility in the short-run. An alternative explanation is that no such rules needed to be followed. This does not imply that international cooperation is always unnecessary. For example, during the interwar period, economists such as Cassel and Hawtrey warned that there was a need for central banks to allow a redistribution of gold within the system so as not to disturb the real price of gold. However, this is a different concern than the traditional *rules of the game*. Thus, whether or not the *rules of the game* were important hinges on the empirical

support for the PSFM. If the evidence supports the PSFM, then discussion of the rules of the game are likely important to a well-functioning system. On the other hand, if the evidence favors the monetary approach, then violations of the rules of the game are not so relevant.

1.2 Literature Review

The PSFM is considered the orthodox view of how the classical gold standard worked - Michael Bordo (1984) calls it the "traditional approach." There have, however, been variations of this theory. For instance, Ricardo (1811) is of the view that arbitrage occurs in only the gold market, and this together with the adherence of countries to convertibility are what drive the PSFM. Thornton (1802) points to the fact that convertibility of currencies across different countries makes foreign trade easier and hence causes prices to adjust across countries. Mill (1884) compares the PSFM to a barter trade of imports and exports. According to Mill, if a country imports more than it exports, it must make up for the remaining imports by a gold outflow. Cairnes (1965) focuses on interest rates and the capital market as the facilitators of the adjustment mechanism.

Even though the PSFM is the conventional view, not much has been done empirically, to verify it's implications. Jacob Viner et al. (1924) presented evidence that Canada depicted the quintessential case of the PSFM. However, Rich (1984) reexamined this evidence and found very little support for the PSFM in the short-run, but some evidence to support the PSFM in the long-run.

Despite the fact that the PSFM is considered to be the orthodox view, there is an alternative view that dates back at least to Adam Smith. For some time, economists found it puzzling that Hume's PSFM was never incorporated into Smith's work. This was not an oversight, but rather due to "his adherence to what is now known as the monetary approach to the balance of payments" (Humphrey, 1981, 3).[1]

The monetary approach was advanced by Williamson (1964), in his study of the balance of

[1]See also, Laidler (1981) and Glasner (1985).

payments in the US between 1820 and 1913. He suggests that gold only flowed to meet excess money demand and had very little to do with differences in prices. McCloskey and Zecher (1976) similarly apply this theory to explain the adjustment mechanism during the classical gold standard. They conduct two tests with the aim of presenting the monetary approach as a better explanation than the PSFM. First, they test correlations between domestic and foreign prices and find a high positive correlation. The positive relationship however, does not necessarily rule out the PSFM because it could imply the price adjustment is faster than first thought. Second, they test a monetary approach prediction of gold flows in the following way. They compute the part of annual money supply attributable to gold flows as the product of the textbook money multiplier and observed gold flows. They then estimate the predicted effect of gold on the money supply as the difference between the money supply predicted by a money demand equation and the domestic money supply. They observe a close match between the computed actual effect of gold flows and the predicted effect, thereby offering stronger support for the monetary approach.

In examining the Swedish experience with the gold standard, Jonung (1984) does not find a close link between the money supply and gold flows. However, he does argue that Swedish prices were strongly correlated with foreign prices. In particular, he finds evidence that the contemporaneous correlation between the price level in Sweden and the U.K. is not only strong, but much higher than the correlations for other leads and lags. In addition, he highlights the strong correlation between the price of wheat and rye in Sweden with the same prices in other countries that was identified by Jörberg (1970). This evidence supports the idea of purchasing power parity and the quick convergence of international price adjustment emphasized in the monetary approach to the balance of payments.

Craig et al. (1995) study price levels and the money supply for the US and some European countries during the gold standard era (1873 - 1913). Using correlation and cointegration tests, they also observe a strong relationship between price levels but a weak relationship between money growth rates across countries. They attribute the strong price level relationship to arbi-

trage and the disparities in money growth rates to attempts by central banks to meet changing domestic money demand. Hence, their results also support the monetary approach.

Although these authors cite support for the monetary approach, they do not test the implications of the PSFM in the same breadth. A gap in the literature is an actual side-by-side comparison of these theories to find which one is consistently supported by the data.

1.3 Methodology

The aim of this study is to determine the relative validity of the PSFM and the monetary approach to the balance of payments. The implications of each of the two approaches differ in important ways. For example, under the PSFM, the short-run behavior of the price level in gold standard countries should be negatively correlated. Since domestic prices rise relative to international prices, this alters the relative demand for domestic and foreign goods. This change in relative demand will persist until relative prices converge. This short-run convergence in prices implies that prices move in opposite directions in the short run. By contrast, according to the monetary approach, the short-run behavior of the price level in one gold standard country should be positively correlated with that of all other gold standard countries. International arbitrage ensures that prices cannot deviate for any extended period of time. Changes in the price level are not caused by changes in the domestic money supply, but rather by fluctuations in the gold market. Thus, the price levels will be positively correlated in both the short run and the long run.

A second important difference between the PSFM and the monetary approach is in the explanation of gold flows. According to the PSFM, a deviation between the price levels in two different countries will alter the balance of trade that is offset by a corresponding change in gold flows. As a result, price level deviations should explain gold flows. In the monetary approach to the balance of payments, gold flows are the result of deviations between the money supply and money demand that are not corrected through the domestic money supply.

Finally, the PSFM implies that the quantity theory holds for domestic economies. In contrast, the monetary approach implies that the world price level is determined by the supply and demand for gold and that the level of domestic prices adjusts to clear the gold market. Thus, according to the monetary approach, the world price level should be a better predictor of the domestic price level than any change in the domestic money supply.

I compare the validity of the two theories in the following manner. First, using annual data I examine the correlation between the price level in each of six gold standard countries and the price level in Britain. A negative correlation between price levels would support the PSFM whereas a positive correlation would support the monetary approach. Second, I examine the relationship between relative prices and gold flows using a direction of change test, a panel model, and estimated impulse response functions. I also examine the relationship between domestic inflation and domestic money growth and domestic inflation and world inflation. Again, I examine the correlations in the data, conduct direction of change tests, and estimate impulse response functions of inflation to shocks to the growth rate of the monetary base and shocks to world inflation.

1.4 Price Level Behavior Across Countries

According to Hume, when the domestic money supply increases, the price level in that country increases relative to international prices, which makes imports cheaper than exports. Gold flows out in payment of the imports. This outflow of gold leads to a reduction in the domestic money supply. This process continues until relative prices are restored. This theory implies that there should be a strong positive correlation between domestic and international prices in the long run, but a negative correlation between domestic and international prices in the short run; or, at the very least, that the correlation should be biased toward zero. The difference in correlations is due to the fact that convertibility restricts the money supply in the long run, but the money supply can deviate from this long-run constraint during short time horizons.

Given that we are using annual data, evidence of a positive correlation could mean that domestic prices converge to international prices quickly, so that discrepancies during the adjustment period were non-discernible. In other words, the use of annual data means the second notion cannot be completely dismissed, due to the possibility of price adjustment occurring within a year. In general, it is quite implausible to view one year as sufficient for adjustment. For example, if each of the variables responds with a one quarter lag, then one year would seem to be a lower bound for the process to complete.[2] If one adopts the monetarist assumption of long and variable lags, then one year does not seem sufficient for complete adjustment. Nonetheless, I take the conservative view that whilst a negative correlation between price levels will make a strong case for the PSFM, a positive correlation does not necessarily rule it out.

The monetary approach, on the other hand, claims this period was typified by an international market where prices were kept similar across countries by arbitrage. Any differences in prices are attributed to tariffs and transportation costs. McCloskey and Zecher (1976) argue that due to a unified international market, just the knowledge of the ease of trade across borders is enough to keep prices in different countries highly correlated. Even prices of non-tradable goods like labor are kept similar due to factor price equalization (Samuelson, 1948). A strong positive correlation between prices would therefore support the monetary theory argument whereas a negative correlation would be evidence against the monetary approach.

To examine these claims regarding the behavior of the price level, I use annual data from the UK, the US, Sweden, Germany, Italy, France and Norway - seven of the countries which formed the core of the gold standard. As in Craig et al. (1995), the classical gold standard era is regarded as the period between 1873 and 1913. Price levels are represented by the GDP deflator, but in keeping with McCloskey and Zecher (1976) and Craig et al. (1995), I show results with consumer and wholesale price indices as alternative definitions of price level in the Appendix. The UK is widely regarded as the country central to the operation of the gold standard, due in

[2]For example, suppose that (1) the price level responds to the money supply with a one quarter lag, (2) the trade balance and therefore gold flows respond to relative prices with a one quarter lag, and (3) the money supply responds to gold flows with a one quarter lag. This would imply that an increase in the money supply in the first quarter would not lead to a correction in the price level until the first quarter of the following year.

part, to the wide circulation of the sterling within the large British empire and the fact that many countries kept cash reserves in sterling. I therefore use UK prices as the relevant comparison for all other countries.

Table 1.1: Correlations between Price Levels, 1873 - 1913

	UK	US	Sweden	Germany	Italy	France	Norway
UK	-	0.90	0.80	0.81	0.69	0.25	0.63
US		-	0.78	0.86	0.70	0.28	0.80
Sweden			-	0.53	0.71	0.70	0.95
Germany				-	0.67	-0.02	0.57
Italy					-	0.50	0.73
France						-	0.51
Norway							-

The pair-wise correlations between price levels for the countries under review are shown in Table 1.1. About 87% of the correlations are above 0.5, indicating a strong relationship between prices in different countries, which lends support to the idea of a unified international market. While these high correlations do agree with the tenets of the monetary approach, I hesitate to make any conclusions with regard to the PSFM simply because the data has annual frequency. One may argue that the effects of money supply changes on prices are delayed and so it may be worth considering lagged values. As McCloskey and Zecher (1976) point out, the positive contemporaneous correlations observed would be almost impossible if the effects were that slow. Also, a negative correlation between lagged values of prices does not provide any information regarding the monetary approach.

1.5 What Determines the Flow of Gold?

According to the PSFM, gold flows out of a country when the price level increases relative to the rest of world. When domestic prices rise, there are more imports because imports are cheaper, leading to a balance of payment deficit. Gold therefore flows out to pay for the excess imports. This implies increases in relative prices should be positively correlated with gold outflows, at least with a lag. Also, relative price changes, as a variable, should provide a good forecast of

gold outflows.

The monetary approach, however, posits that a surplus or deficit in the balance of payments is caused by a discrepancy between the domestic supply of and demand for money rather than changes in domestic prices. According to the monetary approach, gold flows into a country to satisfy the domestic money demand if this demand is not met by the domestic money supply. The validity of the monetary approach explanation is determined by whether excess money demand is a good predictor of gold flows.

To test these theories, I first look at the correlations between gold flows and each of relative price changes and excess money supply. I then proceed to compare the performances of the forecast models implied by the theories, using a directional change criterion and out-of-sample tests.

1.5.1 Correlations with Gold Flows

The competing predictors of gold flows are changes in relative prices and excess money demand (or excess money supply). Relative price changes are measured as the change in the ratio of domestic to UK prices.[3] To measure excess money demand, I first estimate a money demand model of the form:

$$m_t - p_t = \alpha_0 + \alpha_1 y_t + \alpha_2 i_t + \epsilon_t \tag{1.1}$$

where m is the natural log of the money supply, p is the natural log of the price level, y is the natural log of real income, and i is the nominal interest rate. Given this money demand equation, desired real money balances can be defined as the predicted value of real balances, given real income and the interest rate. Thus, ϵ_t can be thought to measure the difference between actual real money balances and desired real money balances. As such, this measure captures excess money supply at the current price level when positive and excess money demand at the current price level when negative. Given that the monetary approach to the balance of

[3]The relative price change at time t, π_t, is given by $\frac{P_t}{P_t^{UK}} - \frac{P_{t-1}}{P_{t-1}^{UK}}$

payments suggests that gold flows are predicted by deviations between the money supply and money demand, we should expect this measure to explain gold flows.

Table 1.2 shows correlations between relative price changes and gold flows for each country. I obtain data on gold flows covering the same period for the countries mentioned earlier. Gold flows are defined as the net export of gold and so a positive value represents an outflow, whilst a negative value represents an inflow. According to the monetary approach, excess money supply should cause a gold outflow. Therefore, to make the sign comparable with the positive sign implied by relative price changes from the PSFM, I use excess money supply as the variable representing the monetary approach. For each method, the first column shows contemporaneous correlations, whilst the second represents correlations when one lag of the explanatory variable is used.

First, I consider the contemporaneous correlations between relative price changes and gold flows, as suggested by the PSFM. Table 1.2 shows both negative and positive correlations, but all the correlations are small in magnitude, the average being -0.05. Even if we consider the possibility that relative price changes causes gold flows with a lag, the correlations are still small, with an average of 0.06. All these contradict the strong positive relationship one would expect under the PSFM. The weak relationship, however, is in line with the monetary theory.

Turning to the monetary approach, we observe larger correlations between excess money supply and gold flows both contemporaneously and with a lag. The average contemporaneous and lagged correlations are 0.06 and 0.12 respectively, which are larger than the averages for relative price changes. In general, all the correlations are small in magnitude and do not offer overwhelming support for the monetary approach, but they do contradict the PSFM.

1.5.2 Direction of Change Criterion

The Henriksson-Merton Method

A central aspect of testing these theories is the evaluation of their predictions of the direction of gold flows, which is a qualitative forecasting exercise. Hence, a test of directional change

Table 1.2: Correlations with Gold flows

	Relative Price Changes		Excess Money Supply	
Country	Contemporaneous	One lag	Contemporaneous	One lag
US	-0.23	-0.06	0.45	0.43
Sweden	0.06	0.26	0.17	-0.07
Germany	-0.03	0.11	0.00	0.16
Italy	0.02	-0.02	0.09	0.05
France	0.05	-0.24	0.12	0.43
Norway	-0.17	0.31	-0.25	-0.27

is appropriate. Henriksson and Merton (1981) - hearafter referred to as HM, formulated such a test to assess the accuracy of predictions made by market timers about the performance of stocks.[4] The test is described as follows: Let $p_1(t)$ be the probability of correctly predicting a positive directional change and $p_2(t)$, the probability of correctly predicting a negative directional change.[5] For a forecast to be considered valuable, a necessary and sufficient condition is that $p_1(t) + p_2(t) > 1$. This implies that, on average, the model should give a correct prediction at least half of the time, for each direction. In determining whether a forecast is useful, one would test the null hypothesis that $p_1(t)+p_2(t) = 1$ against the alternative that $p_1(t)+p_2(t) > 1$. A forecast is deemed useful if the null hypothesis is rejected. The conditional probabilities of correct predictions, given the direction, are sufficient statistics for a non-parametric test of predictive ability. To compute the relevant probabilities under the null hypothesis, the following are required: Let N_1 be the number of observations of a positive direction, N_2, the number of observations of a negative direction, and $N \equiv N_1 + N_2$ be the total number of observations. Also, let n_1 be the number of correct predictions, given a positive direction and n_2 be the number of incorrect predictions, given a negative direction; and so $n \equiv n_1 + n_2$ is the number

[4] Cumby and Modest (1987) and Pesaran and Timmermann (1994) are some of the extensions of this method. Easaw and Heravi (2004) apply it in testing the usefulness of various measures of consumer sentiment as predictors of consumption behavior.

[5] As stated earlier, the use of net gold exports to depict gold flows means a positive direction is a gold outflow and a negative direction is an inflow.

of predictions that the direction is positive. The estimate of the statistic $p_1 + p_2$ is given by

$$\hat{p}_1 + \hat{p}_2 = \frac{n_1}{N_1} + \frac{N_2 - n_2}{N_2} \tag{1.2}$$

If a model makes m predictions of a positive direction, the conditional probability that x of those predictions are correct is given by

$$P(n_1 = x | N_1, N_2, m) = \frac{\binom{N_1}{x}\binom{N_2}{m-x}}{\binom{N}{m}} \tag{1.3}$$

Thus, under the null hypothesis, n_1 has a hypergeometric distribution with a feasible range

$$\underline{n}_1 \equiv max(0, n - N_2) \leq n_1 \leq min(N_1, n) \equiv \overline{n}_1 \tag{1.4}$$

The null hypothesis is rejected at a confidence level of v if $n_1 \geq x^*(k)$ where $x^*(k)$ is the solution to

$$\sum_{x=x*}^{\overline{n}_1} \binom{N_1}{x}\binom{N_2}{n-x} / \binom{N}{n} = 1 - v \tag{1.5}$$

The test has the advantages of being non-parametric and insensitive to sample size. These make it especially appropriate for this task due to the small sample size of the available data and the qualitative nature of this evaluation.

Results of HM Test of Gold Flows

The results of the HM tests are presented in Table 1.3. For the US and Norway, neither method offers useful forecasts. This is shown by the fact that none of the test statistics exceeds unity and the p-values are quite large, the least being 0.66 for these countries. For Sweden and France, the PSFM provides better forecasts, even though the monetary theory forecasts can be considered useful at a 20% level of significance. For Germany and Italy, the monetary theory gives useful forecasts, even at a 5% significance level, but the PSFM does not. The monetary

theory appears to be a marginally better predictor, overall. However, none of the models seems to be completely superior in forecasting the direction of flow of gold for all the countries under consideration.

Table 1.3: Evaluation of directional forecasts of gold flows

	Relative Inflation		Excess Money Supply	
Country	HM stat	p-value	HM stat	p-value
US	0.70	0.95	0.73	0.92
Sweden	1.20	0.02	1.11	0.17
Germany	0.94	0.46	1.30	0.03
Italy	0.91	0.59	1.31	0.01
France	1.28	0.02	1.09	0.20
Norway	0.83	0.72	0.86	0.66

1.5.3 A Panel Model to Explain Gold Flows

In addition to the above methods, I turn to panel models to ascertain which variable better explains gold flows. I use relative price changes (PSFM) and excess money supply (monetary approach) individually, as explanatory variables to estimate gold flows. For relative price changes, I estimate the following model:

$$g_{it} = \beta_0 + \beta_1 \pi_{it} + C_i + \epsilon_{it} \tag{1.6}$$

where g_{it} is net export of gold in country i at time t, π_{it} is the relative price changes of country i in comparison to the U.K. at time t, C_i is a country fixed effect and $\epsilon_{i,t}$ is an error term. The same equation is estimated as

$$g_{it} = \beta_0 + \beta_1 \pi_{it} + \beta_2 g_{i,t-1} + C_i + \epsilon_{it} \tag{1.7}$$

with a lagged value of gold flows to account for the possibility that current gold flows depends on gold flows in the previous period.

The same is done for the excess money supply variable by estimating

$$g_{it} = \beta_0 + \beta_1 m_{it} + C_i + \epsilon_{it} \tag{1.8}$$

where m_t represents the excess money supply and

$$g_{it} = \beta_0 + \beta_1 m_{it} + \beta_2 g_{i,t-1} + C_i + \epsilon_{it} \tag{1.9}$$

Table 1.4 illustrates the results from estimation of the above equations. For the contemporaneous values, the estimated coefficients of both variables are not significant even at the 10% level. Excess money supply is nonetheless a better explanatory variable as shown by the lower p-values. The coefficients when one lag of the gold outflow variable is included are all significant at any level. However, the sign for relative price changes is negative, which is contrary to the PSFM prediction. These results corroborate the correlations, in that, it lends some support to the monetary theory, but to some extent contradict the PSFM.

Table 1.4: Relative Price Changes vs Excess Money Demand

	Relative Price Changes		Excess Money Supply	
	Contemporaneous	One lag	Contemporaneous	One lag
Panel A: Lagged gold flows not included				
β_1	13.05	-67.33	1.38	313.72
	(0.54)	(0.00)	(0.17)	(0.00)
R^2	0.28	0.31	0.28	0.30
Panel B: Lagged gold flows included				
β_1	2.81	-77.40	1.53	268.79
	(0.89)	(0.00)	(0.12)	(0.00)
R^2	0.39	0.40	0.37	0.39

* Note: p-values are in parenthesis. Regressions in Panel A are based on (3) and (5); those in Panel B are based on (4) and (6).

1.5.4 Impulse Response Functions

As a final test of the effect of relative prices on gold flows, I estimate h equations of the form:

$$g_{t+h} = \alpha + \beta_h \Delta\text{Rel}_t + \gamma_1 g_{t-1} + \gamma_2 \Delta\text{Rel}_{t-1} + e_{t+h} \tag{1.10}$$

where g_t is the net export of gold, ΔRel_t is the change in the relative price level of the domestic country relative to the world, and β_h is an estimate of the h-period ahead response of gold exports to a shock to a change in relative prices. Formally, the change in relative prices is measured as

$$\Delta\text{Rel}_t = \left(\frac{P_t}{P_t^*} - \frac{P_{t-1}}{P_{t-1}^*} \right)$$

where P_t^* is a measure of world prices. For the U.S., Sweden, Norway, Italy, France, and Germany, this is measured as the price level in the U.K. For the U.K., this is measured as the price level in the U.S.

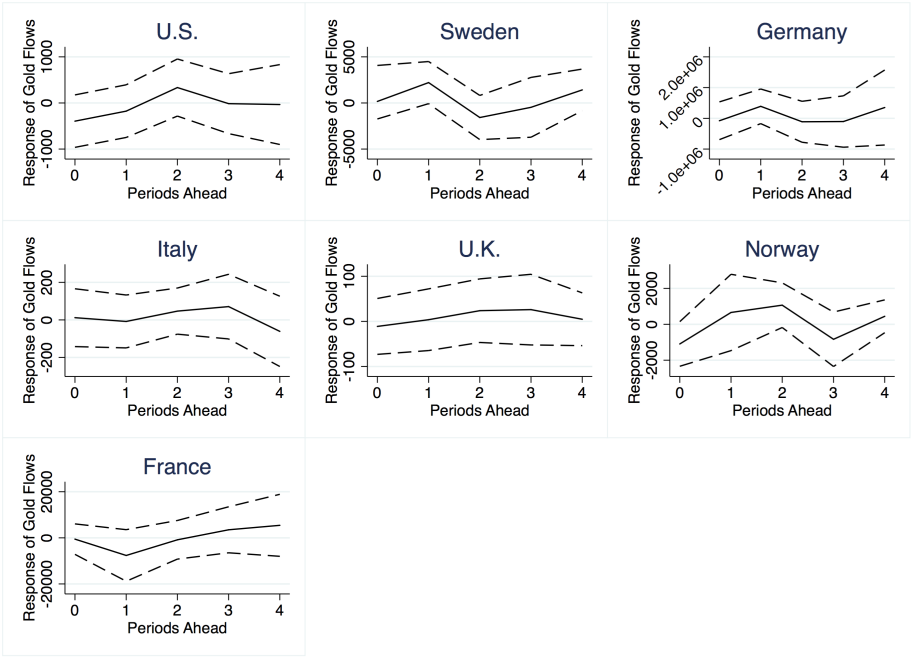

Figure 1.1: The Impulse Response of Net Gold Exports to Changes in Relative Prices.

The results are shown in Figure 1. The solid line plots the point estimates and the dashed

lines plot the 95% confidence interval. The confidence interval is constructed using Newey-West standard errors. As shown, the response of net gold exports to a shock to a change in relative prices is not statistically different from zero for any of the seven countries. This analysis therefore does not provide support for the PSFM.

1.6 What Explains Domestic Inflation?

Under the PSFM, the quantity theory applies to the domestic money supply. In short, according to the PSFM, increases in the domestic money supply result in an increase in the domestic price level and an increase in the relative prices of domestic goods. The increase in relative prices causes exports to decline and imports to increase. Assuming the starting position of balanced trade, this results in a gold outflow. The outflow of gold causes a reduction in the money supply and a restoration of the long-run equilibrium relative price of domestic goods.

In contrast, according to the monetary approach to the balance of payments, the quantity theory applies to gold. An excess demand for (supply of) monetary gold leads to an increase (a reduction) in the real price of gold. Since the nominal price of gold is fixed in all countries on the gold standard, the domestic price levels must adjust to clear the market for gold. Price levels therefore move in concert. Any deviations between the supply of and demand for money are corrected through the balance of payments and do not affect the price level.

This contrast provides testable predictions. If the gold standard worked through the PSFM, one would expect to find that inflation is explained by the growth of the domestic money supply. Furthermore, traditional quantity theoretic arguments would suggest that there is a lag in the effect of money growth on inflation. On the other hand, if the monetary approach to the balance of payments better describes the adjustment mechanism under the gold standard, then one would expect that shocks to world inflation would cause an increase in domestic inflation. Furthermore, given the important role of arbitrage, one would expect that shocks to world prices have their largest effect contemporaneously.

To examine these claims, I estimate the correlations between money growth and inflation, as well as U.K. inflation and domestic inflation. I also conduct direction of change tests and estimate impulse response functions.

1.6.1 Correlations with Domestic Inflation

The simple correlations referred to above, are shown in Table 1.5. The world inflation is depicted by inflation in the UK. Correlations with one lag of each variable are also included to account for the possibility, that the effects of these variables are delayed. Table 1.5 shows a general positive correlation between each variable and domestic inflation. However, the correlations with the world inflation variable are larger than those with money growth for every country, when both contemporaneous and lagged values are used.

Table 1.5: Correlations with Domestic Inflation

	Money Growth		World Inflation	
Country	Contemporaneous	One lag	Contemporaneous	One lag
US	0.56	0.50	0.73	0.74
Sweden	0.54	0.40	0.54	0.61
Germany	0.45	0.47	0.48	0.52
Italy	0.18	0.17	0.22	0.20
France	-0.05	-0.04	0.37	0.41
Norway	0.59	0.61	0.59	0.68

1.6.2 Direction of Change Criterion

The HM approach described earlier, is used to compare the abilities of money growth and world inflation in predicting the direction of change of inflation. Table 1.6 illustrates the results. Both variables can be considered useful depending on the level of significance, since all the values of the test statistic are greater than unity. If we restrict the level of significance to 10%, however, money growth can be considered useful in forecasting inflation for only the US, Sweden and Norway. World inflation, on the other hand, provides better forecasts for every country. All the values of the test statistic for world inflation are greater and have greater statistical

significance than the corresponding values for money growth. Hence, the predictions made by world inflation are useful for every country, but the same cannot be said about the predictions made by money growth. The monetary theory approach, thus provides a more credible theory of changes in the direction of domestic inflation than the PSFM.

Table 1.6: Evaluation of Directional Forecasts of Domestic Inflation

	Money Growth		World inflation	
Country	HM stat	p-value	HM stat	p-value
US	1.25	0.00	1.60	0.00
Sweden	1.13	0.00	1.46	0.00
Germany	1.05	0.17	1.40	0.00
Italy	1.07	0.16	1.26	0.03
France	1.11	0.14	1.31	0.01
Norway	1.10	0.05	1.40	0.00

1.6.3 Impulse Response Functions

The final method of analysis in this section is to estimate the impulse response functions of inflation to shocks to money growth and world inflation. In order to estimate the effect of a shock to money growth, I estimate h regressions of the form:

$$\pi_{t+h} = \alpha + \beta_h \Delta m_t + \gamma_1 \pi_{t-1} + \gamma_2 \Delta m_{t-1} + \gamma_3 \pi^*_{t-1} + \epsilon_{t+h} \tag{1.11}$$

where π is the domestic inflation rate, Δm_{t-1} is the growth rate of the monetary base, and π^* is the "world inflation rate" that is measured by U.K. inflation for all countries except the U.K. and by U.S. inflation for the U.K. The use of the U.K. inflation rate is as a stand-in for the world inflation rate. Here, $\hat{\beta}_h$ is the estimate of the effect of a shock to money growth on domestic inflation h periods ahead.

The impulse response functions for the U.S., Sweden, Germany, Italy, the U.K., and Norway are shown in Figure 1.2. As shown, a shock to the growth rate of the monetary base is initially positive for all six countries, but this effect is only statistically different from zero for Norway

and Germany. Furthermore, there is no evidence that the growth rate of the monetary base affects the inflation rate with a lag, with the exception of Norway. In fact, there is a statistically significant lag in the effect of shocks to the monetary base for Sweden, but the direction of the effect is the opposite of what the quantity theory would predict. Overall, there is little evidence in favor of the quantity theory of money. This is important because the PSFM suggests that one essential source of deviations between domestic and foreign prices is a change in the domestic money supply. The PSFM also implies that declines in the monetary base should lead to a correction in relative prices. The absence of evidence in support of the quantity theory of money is therefore strike against the PSFM.

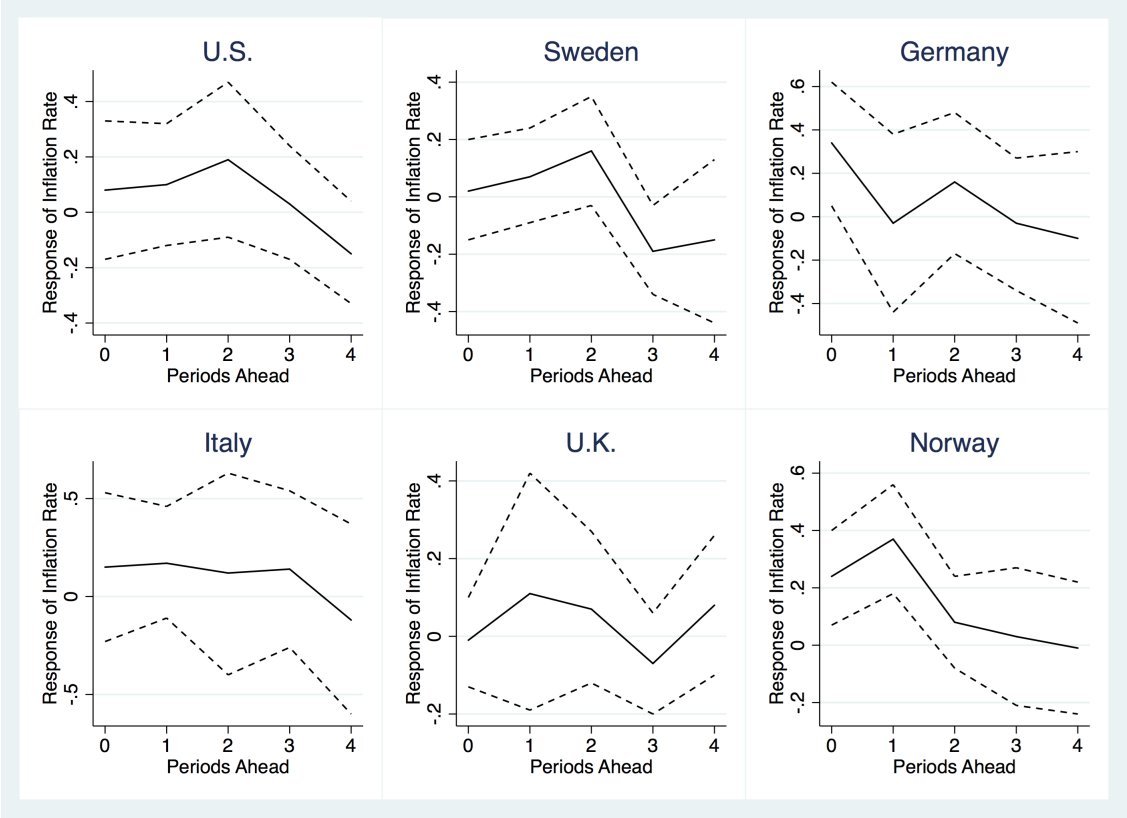

Figure 1.2: The Impulse Response of Domestic Inflation to Money Growth

To estimate the effect of shocks to the world price level on the domestic price level, I estimate

h regressions of the form:

$$\pi_{t+h} = \alpha + \beta_h \pi_t^* + \gamma_1 \pi_{t-1} + \gamma_2 \Delta m_{t-1} + \gamma_3 \pi_{t-1}^* + \epsilon_{t+h} \tag{1.12}$$

where the variables are defined as above. Here, the estimate, $\hat{\beta}_h$ measures the effect of a shock to the world inflation rate on the domestic inflation rate h periods ahead.

The impulse response functions for the U.S., Sweden, Germany, Italy, the U.K., and Norway are shown in Figure 1.3. A shock to "world prices" causes an increase in the domestic price level for all six countries. These increases are statistically different from zero for every country, with the exception of Italy. In addition, the effect is immediate and therefore consistent with adjustments due to arbitrage, as the monetary approach to the balance of payments would suggest.

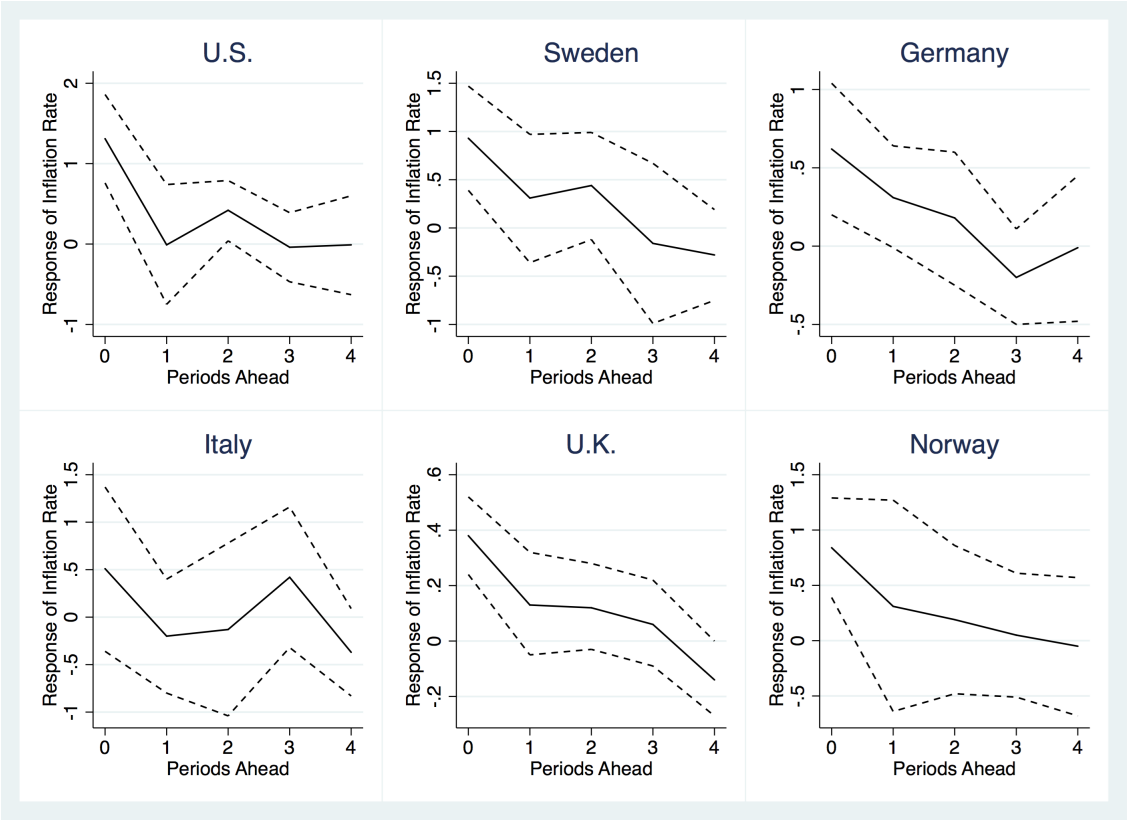

Figure 1.3: The Impulse Response of Domestic Inflation to "World Inflation"

Overall, the impulse response functions provide little support for the PSFM. However, there

is relatively consistent evidence in favor of the monetary approach to the balance of payments.

1.7 Conclusion

In comparing the two theories, I set out to answer the following questions: (1) Was the period characterized by a fluctuation in relative prices or a stability in relative prices kept by arbitrage? (2) Are gold flows better explained by relative price changes or deviations from long run money demand? (3) Is domestic inflation better explained by money growth or world inflation. I attempt to answer these using data on seven of the countries central to the classical gold standard system.

To answer the first question, I examine the correlations between the price level of a given country and the U.K. I generally observe strong positive correlations. This is consistent with the monetary approach to the balance of payments. Whether or not this is consistent with the PSFM depends on how rapidly gold flows and deviations in relative prices adjust.

In addressing the second question, I perform three types of analysis. First, I examine the correlations between relative price changes and gold flows to test the PSFM assertion that changes in relative prices lead to corresponding changes in gold flows. The small size of the correlations observed contradicts this assertion. Second, using the HM approach, I compare the directions of gold flows predicted by each theory and find that neither of the theories gives a consistent enough prediction of the correct direction. Hence, the PSFM prediction of gold flows is contradicted by the data, but there is not strong support for the monetary approach either. Finally, I estimate impulse response functions for the response of gold exports to a shock to changes in relative prices. I find no support for the idea that relative price shocks have an effect on gold flows.

A similar approach is used in answering the third question. I observe stronger correlations between world and domestic inflation than between money growth and domestic inflation. I also find that world inflation performs better than money growth in predicting the direction of domestic inflation. Impulse response functions provide support for the quantity theory as

it relates to the domestic economy for Norway and marginal support for Germany. There is no support for the quantity theory in the remaining countries. However, I find support for the idea that shocks to world inflation caused immediate changes in domestic inflation for every country except Italy. This is strong support in favor of the monetary approach to the balance of payments.

Overall, the evidence is somewhat mixed. It is difficult, for example, to draw any conclusions about the empirical relevance of either theory. To the extent that one can generalize the results, there seems to be little evidence that change in relative prices are important for explaining gold flows. There is some evidence that deviations of real balances from long-run money demand explain gold flows, but the evidence isn't consistent across countries. The correlation between international price levels and the estimated impulse response functions seem to favor the monetary approach to the balance of payments. Thus, while the evidence is mixed overall, there is greater support for the monetary approach to the balance of payments than for the PSFM. This seems to confirm Temin's (1984, p. 577) previous comment that "tests of the price-specie-flow theory have generally been negative."

1.8 Data Appendix

Data on gold flows for every country are taken from Jones and Obstfeld (1997). The data on gold flows are in millions of the domestic currency. I use broad measures of money to represent money supply for estimating money demand, but the monetary base for estimating quantity theoretic predictions; and interest rates are rates on long term government bonds, unless otherwise stated.

For the UK data on GDP, GDP deflator, money supply and interest rates are taken from Friedman and Schwartz (1983). Interest rates are depicted by yields on consols. The consumer price index (CPI) is taken from Feinstein (1972) and the wholesale price index (WPI) is taken from Mitchell (1980).

I obtain data on data on GDP, GDP deflators, money supply and interest rates also from Friedman and Schwartz (1983) for the US. Interest rates are represented by yields on corporate bonds. CPI data come from the Federal Reserve Economic Data (FRED) website.

Data on GDP and the GDP deflator are provided by Krantz and Schön (2007) whilst Edvinsson et al. (2014) give data on money supply and interest rates for Sweden.

For Germany, I obtain data on GDP, GDP deflator and price indices from Rahlf (2015) and money supply from Sprenger (1982). Interest rates are however taken from FRED.

I draw on Fratianni and Spinelli (1984) for all variables for Italy, except net gold exports, as mentioned earlier.

For France, GDP and price indices are given by Mitchell (1980); the GDP deflator comes from Lévy-Leboyer and Bourguignon (1990); money supply is obtained from Saint Marc (1983); and interest rates are supplied by Fratianni and Spinelli (1984).

Klovland (1983) provide data on GDP, GDP deflator, money supply and interest rates whilst data on price indices are given by Mitchell (1980) for Norway.

1.9 Price Level Behavior Across Countries: Alternative Definitions of the Price Level

Correlations between price levels (consumer and producer price indices), 1873 - 1913

	UK	US	Sweden	Germany	Italy	France
UK	-	0.695	0.793	0.242	0.753	0.615
		0.550	0.824	0.651	0.812	0.958
US		-	0.879	0.755	0.690	0.561
			-	-	-	-
Sweden			-	0.706	0.746	0.574
				0.940	0.888	0.919
Germany				-	0.468	0.435
					0.800	0.776
Italy					-	0.572
						0.885
France						-

Chapter 2

Effects of Immigration on Female Labor Market Outcomes

2.1 Introduction

Immigrants have increasingly become a major part of the labor force in the United Sates (US). Whilst immigrants formed only 5% of the US labor force in 1970, they accounted for 17% of the work force in 2018. In theory, such increase in immigration should lead to increased labor supply and therefore a decrease in overall wages, at least in the short run. This is reflected in the literature, as studies on the wage impact of immigration have largely found either no significant effect or a small negative effect of immigration on wages of natives. Studies such as Altonji and Card (1991) and Grossman (1982) which use spatial correlation methods based on city-level data usually find only a small effect of immigration on wages of natives. On the other hand, studies pioneered by Borjas (2003), which use nationwide aggregate data show that immigration has a much more significant effect on the wages of natives.

Implementation of the national level framework aims at addressing some challenges which accompany the spatial correlation framework. For instance, the use of national level data helps overcome the problem of spatial arbitrage inherent in spatial correlation methods. In addition,

this method controls for human capital - a fundamental determinant of wages, by putting all observations into skill groups (according to an individual's level of education and work experience). Studies such as Borjas, Grogger, and Hanson (2010), Ottaviano & Peri, 2012 and Manacorda et al. (2012) have focused on male only samples, with females being included only in the robustness tests. This study therefore aims to apply national level approach to examine the differences in the immigration impact on native male and female labor market outcomes.

Using decennial census data from 1960 - 2010, I estimate the effects of an increase in the immigrant proportion of the labor supply on the wages and employment rates of native men and women separately. Individuals are categorized into skill groups based on their educational attainment and number of years of work experience. I find that a 10% increase in the immigrant labor supply depresses the average wage of native women of the same same skill by about 3.5%, but does not significantly affect the wages of native men. However, the effects on the employment rates of both native men and women are small and insignificant.

This result gives further indication of underlying gender differences in the labor market, and I explore these differences as they pertain to immigration. It remains a challenge to clearly identify the causes of gender differences in labor market outcomes. Most of the differences remain unexplained by factors such as human capital, occupational differences, unionization and regional effects and so a large portion of the gap is attributed to labor market discrimination. Using a number of simple tests, I attempt to ascertain to what extent the gender differences in the wage impact of immigration could be accounted for by human capital or occupational differences and to what extent they could be attributed to discrimination.

2.2 Literature Review

This study is at the intersection of female labor market dynamics and immigration economics. Differences in the effect of immigration on the labor market outcomes of native men and women highlight existing gender differences, some of which are examined in the gender wage gap

literature. A variety of approaches have been used in analysing the impact of immigration on the labor market. There are studies that take advantage of a "natural experiment" to overcome the endogeneity problem arising from the fact that many confounding factors can contribute to the observed labor market outcomes. A well-known example is the application of difference-in-differences by Card (1990) in estimating the effect of the Mariel Boatlift on the labor market in Miami. Card (1990) concludes that this event had no significant impact on employment and wages of both immigrants and natives. Angrist and Krueger (1999) reaches a similar conclusion after investigating the impact an announced Mariel Boatlift in 1994 would have had on native wages, had it happened. Using the repatriation of Africans to Portugal in the 1970s as a natural experiment, Carrington and De Lima (1996) also found that a lower employment rate existed only among newly arrived immigrants, and so this event did not affect the labor market for natives.

Other studies implement a spatial correlation method, where the impact of immigration is measured by taking differential impacts between similar cities. Card (2001), for instance, finds that a 10% increase in a city's population is accompanied by a 0.28% reduction in the employment rate of native men and a 0.45% reduction in the employment rate of native women. Cortes (2008) focuses on low-skill individuals and also find that immigration only marginally reduces the wages of other immigrants, but does not affect wages of natives. To address the endogeneity problem, these studies use past regional immigration inflow patterns as an instrument for immigration inflow. These studies categorize the data by occupation, but they do not account for differences in education levels between individuals - a factor which could cause significant differences in wages.

To improve upon this method, another strand of literature led by Borjas (2003) uses a skill group as the unit of observation. A skill group is a group of individuals who have similar education and number of years of working experience. Here, the focus is on the entire nation instead of cities. The advantages are that movements of people across cities do not affect the analysis and work experience is considered in addition to education level. Also, the endogeneity

problem is reduced because the national immigrant flow is not as endogenous to labor market outcomes as the city level immigrant inflow. Endogeneity is however still addressed by using the immigrant population as an instrument for the immigrant labor supply. Ottaviano and Peri (2012), Manacorda et al. (2012) and Peri and Sparber (2009) are examples of studies which apply this framework.

In female labor analysis, the consensus is that women have a more wage elastic labor supply than men (Blundell and MaCurdy (1999); Killingsworth (1983); Devereux (2004)). A common reason given is that women usually substitute labor for domestic production and leisure, whilst men mostly substitute labor for only leisure. The elasticities for males and females have become closer with time, due to more women choosing to have careers, but female wage elasticity still remains higher than the male wage elasticity. In addition to differences in wage elasticities, men and women have different labor market outcomes due to reasons such as differences in gender distribution across occupations, differences in average educational attainment or some discrimination against women. (Blau & Kahn, 2017)

Considering studies jointly on female labor supply and immigration, both Farré et al. (2011) and Cortes and Tessada (2011) find that low-skilled immigrants usually take up home production duties which increases the labor supply of highly skilled women. Within the literature which use the national level framework, there has not been much consideration for females. Borjas (2003), Ottaviano and Peri (2012) and Manacorda et al. (2012) all use samples of males and only include females as a robustness check when estimating elasticities of substitution between immigrants and natives. I use this framework to investigate the impact of immigration on the wages and employment rate of females, considering the peculiarities of the female labor market.

2.3 Data and Descriptive Statistics

Selection of samples, construction and specification of variables follow Ottaviano and Peri (2012). I employ US decennial census data obtained from the Integrated Public Use Micro-

data Sample (IPUMS) covering the census years 1960, 1970, 1980, 1990 and 2000. American Community Survey (ACS) data for the years 2009, 2010 and 2011, which I together designate as 2010, are also included. Only people aged 18 to 64 are included in the sample. Non-American citizens and naturalized citizens are classified as immigrants. Any other person is considered a native.

Following Borjas (2003), individuals are put into skill groups based on a combination of their educational attainment and work experience. Regarding educational attainment, there are four categories: high school dropouts, high school graduates, individuals with some college education and college graduates. To estimate the number of years of working experience, it is assumed that high school dropouts start their first employment at 17 years of age, high school graduates at 19 years, individuals with some college at 21 and college graduates at 23. Individuals with more than 40 years of experience are dropped. There are eight categories based on years of experience; one category for every five-year interval (1-5, 6-10, ..., 36-40). These classifications result in 32 skill groups (4 education groups by 8 experience groups) for each census year; hence 192 observations (32 skill groups by 6 census years).

The proportion of labor supplied by immigrants in a skill group in a census year is defined as the ratio of the number of hours worked by the immigrants in the skill group to the number of hours worked by all individuals in that skill group. For each individual, the number of hours worked is multiplied by a person weight (PWT) to make the sample more representative of the population. The labor supply for each skill group and census year is expressed as the total number of hours worked by individuals in that skill group within that year.[1]

Wages for each skill group are represented by the average weekly wage of all individuals in the skill group. People who have not worked or earned any wages in the previous year, reside in group quarters or are self employed are excluded from the wage sample. All wages are deflated by the price index in the year 2000. For each individual, I compute the proportion of

[1]I use the immigrant share of the population as an instrumental variable for immigrant share of the labor supply in the regressions in the sections that follow

weeks worked[2]; and so the employment rate for a skill group is defined as the average of this proportion for all individuals in the skill group.

This study essentially tries to find the change in wages and employment rates of natives associated with an increase in the percentage of immigrants in the labor force. To that end, I present Figures 2.1 and 2.2 as initial illustrations of the relationships I seek to uncover in the following sections. Figure 2.1 shows a scatterplot of the relationship between changes in wages of natives and changes in immigrant share of the labor force, whilst Figure 2.2 does the same for employment rates. In general, all plots show a negative correlation between native labor market outcomes and immigrant labor force participation. For both figures, the slope is marginally greater in magnitude for females than males. These figures do not account for other control variables which may be included in a regression. However, they give an indication to expect some marginally greater negative effects for females.

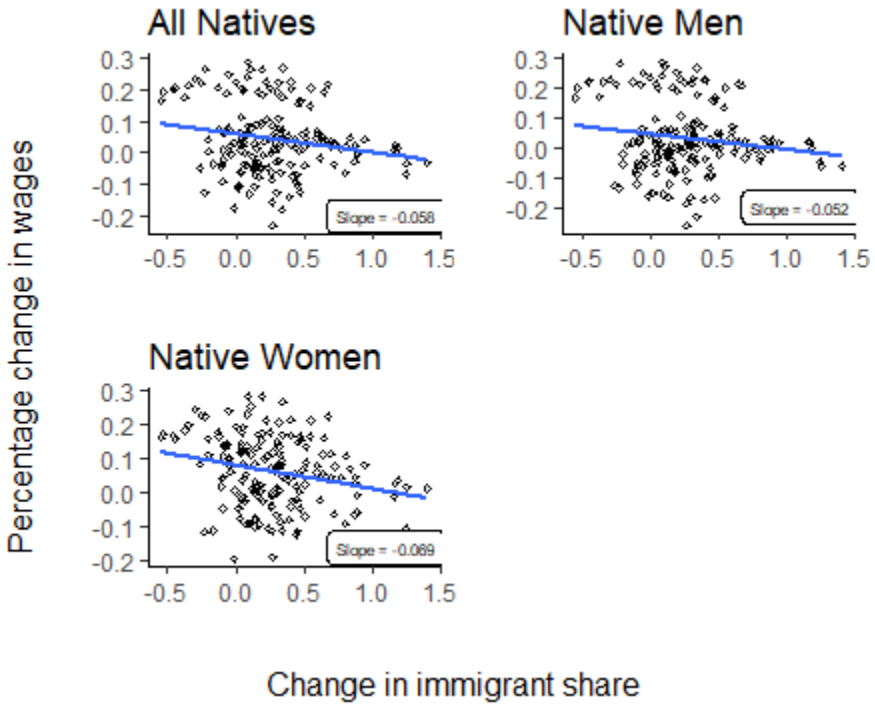

Figure 2.1: Relationship between changes in wages and immigration

[2]That is the number of weeks worked by the person in the previous calendar year, divided by 52

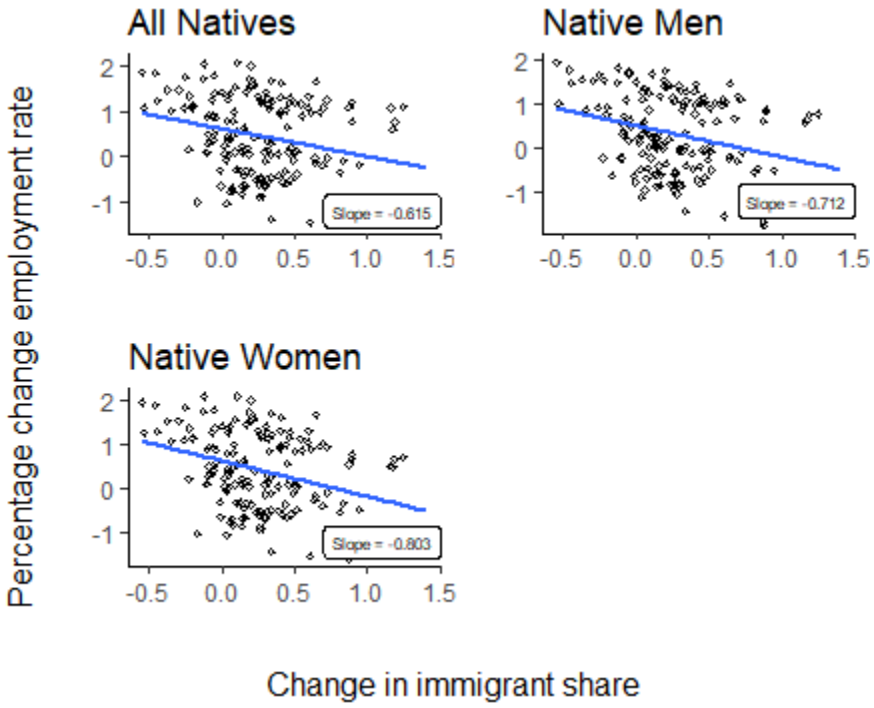

Figure 2.2: Relationship between changes in employment rate and immigration

2.4 Impact of Immigration

I begin by estimating the impact of immigration on labor market outcomes of natives, using the following model.[3]

$$y_{dxt} = p_{dxt} + d + x + t + d{\cdot}x + d{\cdot}t + x{\cdot}t + \epsilon_{dxt} \tag{2.1}$$

where y_{dxt} is the labor market outcome, which is either the employment rate or the log of the weekly wage of native men or women with education level d and x years of work experience in the census year t; p_{dxt} is the share of immigrants in the labor supply who have education level d and x years of work experience. The labor supply is measured in hours worked in the census year[4]; d is an education level fixed effect, x is an experience level fixed effect, t is a census year fixed effect and ϵ_{dxt} represents an error term uncorrelated with education, experience or census year.

[3] I use an approach similar to Borjas et al. (2010)

[4] $p_{dxt} = \frac{I_{dxt}}{I_{dxt}+N_{dxt}}$, I_{dxt} represents the number of hours worked by immigrants and N_{dxt} is the number of hours worked by natives

The results from this estimation are presented in Table 2.1. The first column has a specification which includes skill group fixed effects d, x and $d{\cdot}x$,[5] and census year fixed effects t. The specification in the second column is identical to that of the first, except that each cell is weighted by the number of people employed in the cell. The regressions are weighted to ensure that skill groups with much larger variances have a limited effect on the standard errors of the coefficient, in order to account for heteroskedasticity. The third column has regressions with no fixed effects of any form, but each cell is weighted by the number of employed people, as in Column 2. The specification in Column 4 represents the entire (2.1).

Across all specifications, immigration has a larger negative effect on the wages of native women than the wages of native men. Considering Column 3 - the preferred specification, a 10% increase in the labor supply proportion of immigrants leads about a 3 and a half percentage point reduction in the average wage of native women, but does not lead to a significant change in the average wage of native men of a similar skill level. By using skill groups, these specifications account for the fundamental determinant of labor market outcomes, which is human capital. Inclusion of education, experience and census year fixed and interaction effects caters for any changes in immigrant labor supply which are correlated with human capital and the census year.

Given the comprehensive set of fixed effects, any endogeneity concerns only arise from factors affecting labor supply, which cannot be accounted for by education, experience or the the census year. Immigrant population growth directly increases immigrant labor supply and may not change nearly as quickly in response to changes in relative wages as labor supply would, especially at the national level. Therefore, similar to Borjas et al. (2010), I use the immigrant proportion of the population as an instrumental variable for the immigrant proportion of labor supply. The instrumental variable regressions produce nearly identical coefficients to the least squares regressions.

Panel B of Table 2.1 shows the impact on the employment rate. A slightly different pattern is

[5]These are education fixed effects, experience fixed effects and education by experience interaction effects

observed here. In each specification, there is a stronger impact on the employment rate of men. Neither coefficient in Column 3 is statistically significant, even at the 10% significant level. Unlike the wage regressions where the inclusion of additional interaction effects did not increase the standard errors, including more interaction effects here affects the precision of the estimates. Considering Column 2, which is the preferred specification of Ottaviano and Peri (2012), we could conclude that a 10% increase in the proportion of immigrant labor supply induces a 2.3 percentage point decrease in the employment rate of native men and a 1.9 percentage point decrease in the employment rate of native women. Using the same instrumental variable as in the wage outcomes regressions, I obtain very similar results for each specification. Hence, immigration seems to have almost the same effect on the employment rate of both native men and women - a small effect in both cases.

These results raise questions about what explains the differences in wage impacts and the simultaneous similarities in employment rate impacts. These differential impacts may only be reflecting existing differences in the labor market outcomes of men and women which could not be overcome by the instrumental variable implemented here.[6] The main implication of the differences in wage impacts is that immigrants are somewhat more similar to native women than native men in the labor market. Such similarity may be due essentially to two reasons - either they have similar skills, in which case they are close technical substitutes or they both face some form of labor discrimination which does not affect native men. In what follows I present a set of tests aimed aimed at ascertaining the most plausible explanation for the observed gender differences in the impact on wages. First, I attempt to check if indeed immigrants are closer substitutes to native women than native men. I do this by providing a theoretical framework to depict the elasticities of substitution between two groups and estimating these elasticities with an empirical version of this framework.

[6]This could form part of the broader, well documented exploration into the causes of the gender-wage gap.Blau and Kahn (2017)

Table 2.1: Impact of Immigration on Native Labor Market Outcomes

A. Dependent Variable: Log of weekly wage

OLS Regressions	1 Unweighted	2 No Interactions	3 Full Model
Men	-0.49***	-0.39***	-0.09
	(0.13)	(0.14)	(0.13)
Women	-0.53***	-0.45**	-0.36***
	(0.14)	(0.18)	(0.11)
IV Regressions			
Men	-0.43***	-0.32**	-0.05
	(0.12)	(0.12)	(0.11)
Women	-0.46***	-0.36**	-0.35***
	(0.12)	(0.15)	(0.11)

B. Dependent Variable: Employment rate

OLS Regressions	1 Unweighted	2 No Interactions	3 Full Model
Men	-0.18***	-0.23***	0.09
	(0.03)	(0.05)	(0.15)
Women	-0.15**	-0.19***	-0.08
	(0.06)	(0.07)	(0.18)
IV Regressions			
Men	-0.16***	-0.21***	0.14
	(0.03)	(0.04)	(0.14)
Women	-0.12*	-0.16**	-0.02
	(0.06)	(0.07)	(0.17)

Least Square estimation is used in the first two rows, while Two-stage Least Square estimation is used for the instrumental variable regressions. 192 observations, which comprise 32 skill groups and 6 census years, are used in each regression. Heteroskedasticity-robust standard errors are reported in the parentheses below the coefficient estimates. Standard errors are also clustered by skill groups. *** means the coefficient is significant at the 1% level. ** means significant at the 5% level and * means significant at the 1% level.

2.5 Elasticity of Substitution

2.5.1 Theoretical Framework

Due to the relative convenience of the empirical application, a constant elasticity of substitution (CES) function is usually chosen as the model of production in the economy. I adopt the Borjas (2003) framework which was based on a two-level nested CES production function from Card and Lemieux (2001). In this framework, however, aggregate production is separated into production by pair-wise combinations of immigrants and native men or native women.[7] Aggregate production has the following form

$$Y_t = [\alpha K_t^{\beta} + (1-\alpha) L_t^{\beta}]^{\frac{1}{\beta}} \tag{2.2}$$

where Y_t is aggregate output, K is capital and L depicts the efficiency units from labor, which is a CES aggregate of labor from each skill group, α is a parameter showing the share of income contributed by capital. $\theta_{KL} = 1/(1-\beta)$ is the elasticity of substitution between capital and labor.

The total efficiency units provided by all the skill groups in year t is the CES aggregate

$$L_t = \left[\sum_s \theta_{st} L_{st}^{\nu} \right]^{1/\nu} \tag{2.3}$$

where s denotes the skill group and $\sigma_s = 1/(1-\nu)$ is the elasticity of substitution between any pair of skill groups, which is assumed to be the same for each pair of skill groups.

For people of the same skill group, the CES aggregate labor supplied by a pair of demographic groups, i and j in year t is given by

$$L_{st} = [\lambda_{ist} L_{ist}^{\rho} + \lambda_{jst} L_{jst}^{\rho}]^{1/\rho} \tag{2.4}$$

[7] Card and Lemieux (2001) separate production into production provided by college graduates and high school graduates.

where i represents immigrants and j is a native male or female. L_{ist} is the number of immigrant workers in skill group s and L_{jst} is the number of workers of native type j in the same skill group; λ_{ist} and λ_{jst} are parameters for relative efficiency of skill group s and demographic groups i and j respectively and the elasticity of substitution between immigrants and a native group, j is $\theta_{ij} = 1/(1-\rho)$; $\rho < 1$. A simplifying assumption imposed by the model is that the elasticity of substitution between immigrants and native groups is the same across all skill groups. For example, this means the elasticity of substitution between immigrants and natives who are college graduates with a decade of work experience is the same as the elasticity of substitution between immigrants and natives with a high school diploma and only a year of experience.

The profit-maximization condition based on (2.2) - (2.4), where the wage, w_{ist} of a worker of immigration status i equates to her marginal product is

$$\ln w_{ist} = \ln (1-\alpha)+(1-\beta) \ln Y_t+(\beta-\nu) \ln L_t+ \ln \theta_{st}+(\nu-\rho) \ln Y_{st}+ \ln \lambda_{jst}+(\rho-1) \ln L_{ist} \tag{2.5}$$

This implies relative wages between immigrants (i) and natives of type j in the same skill group has the form:

$$\ln\left(\frac{w_{ist}}{w_{jst}}\right) = \ln\left(\frac{\lambda_{ist}}{\lambda_{jst}}\right) - \frac{1}{\sigma}\ln\left(\frac{H_{ist}}{H_{jst}}\right) \tag{2.6}$$

where σ is the elasticity of substitution between immigrants and natives of type j. If $1/\sigma = 0$, then then immigrants and the native type are perfect substitutes. This implies that a change in the relative labor supply between immigrants and natives of type j has no effect on their relative wages. I apply an empirical approach to estimate these elasticities in the next section.

2.5.2 Estimation

Estimation of (2.6) is done by specifying

$$\ln\left(\frac{w_{ist}}{w_{jst}}\right) = d + x + t + d{\cdot}x + d{\cdot}t + x{\cdot}t - \frac{1}{\sigma}\ln\left(\frac{H_{ist}}{H_{jst}}\right) + \epsilon_{st} \tag{2.7}$$

where I depict relative efficiency ($\frac{\lambda_{ist}}{\lambda_{jst}}$) between immigrants and a native gender group of identical education level and work experience[8] by sets of education, experience, census year fixed and interaction effects identical to those in (2.1). This depiction is non-restrictive because relative efficiency is allowed to have a human capital component based on education and experience, a time component based on the the census year and interactions between these components. The smaller the value of the estimate for $-\frac{1}{\sigma}$, the higher the elasticity of substitution between that native gender group and immigrants. A large value of σ therefore indicates perfect substitutability between a native gender group and immigrants. Hence, a coefficient $-\frac{1}{\sigma}$ not statistically different from zero would imply perfect substitutability.

Results from least squares estimates of $-\frac{1}{\sigma}$ from (2.7) are shown in the first two rows of Table 2.2. The first column has a specification which includes education (d) and experience (x) fixed effects, education by experience interaction effects, $d{\cdot}x$ and census year fixed effects, t. The specification in the second column is identical to that of the first, except that each cell is weighted by the number of people employed in the cell.[9] The third column has regressions with no fixed effects of any form, but each cell is weighted by the number of employed people, as in Column 2. The specification in Column 4 represents the entirety of (2.7), where each cell is weighted as in Column 2.

The estimates across the first three specifications are numerically similar. They range between -0.057 and -0.072 for native men and -0.061 to -0.069 for native women. Based on Column 2 - the most comprehensive specification among the first three, these translate to elasticities of about 14 for men and 15 for women. Whilst specifications in Columns 1-3 suggest

[8] Otherwise known as a skill group

[9] As in Ottaviano and Peri (2012)

similar elasticities, the fourth column indicates a greater difference between native men and women. It shows the elasticity of substitution between native women and immigrants is about twice the elasticity of substitution between native men and immigrants.[10] Also, the estimate for native women is not statistically significant, even at the 1% significance level, which implies that the null hypothesis of perfect substitution between native women and immigrants cannot be rejected. The size of the difference between coefficients in Column 4 and the other columns means the assumption that the relative efficiency between natives and immigrants may be different across skill groups, each census year is important in this case.

Table 2.2: Elasticities - Estimates of $-1/\sigma$

OLS Regressions	1 No weights	2 Weighted	3 No Fixed Effects	4 All Fixed Effects
Men	-0.072***	-0.072***	-0.057***	-0.107**
	(0.011)	(0.012)	(0.008)	(0.041)
Women	-0.069***	-0.067***	-0.061**	-0.048
	(0.017)	(0.021)	(0.023)	(0.030)
IV Regressions				
Men	-0.069***	-0.068***	-0.056***	-0.111**
	(0.011)	(0.013)	(0.008)	(0.043)
Women	-0.067***	-0.064***	-0.044**	-0.047
	(0.017)	(0.021)	(0.021)	(0.031)

Least Square estimation is used in the first two rows, while Two-stage Least Square estimation is used for the instrumental variable regressions. Data comprises 192 observations. Heteroskedasticity-robust standard errors are reported in the parentheses below the coefficient estimates. Standard errors are also clustered by skill groups. ***means the coefficient is significant at the 1% level. **means significant at the 5% level and *means significant at the 1% level.

Ottaviano and Peri (2012) assumes that the census year effects are the same across skill groups. They also believe the addition of skill group and census year interaction effects produces an unnecessarily high number of estimated variables, which lead to larger standard errors, implying the null hypothesis of perfect substitutability is hardly ever rejected. The marginally higher standard errors of the estimates in Column 4 provide some evidence for this. Borjas et al.

[10] Approximately 20 for women and 10 for men

(2008) uses a specification identical to the one in Column 4 and also find that the elasticity of substitution is higher for native women than native men. Using data from Britain, Manacorda et al. (2012) also obtain an estimate for $-\frac{1}{\sigma}$ between immigrants and women, which is not statistically different from zero. According to Manacorda et al. (2012), the results for native women have very little inferential value for a couple of reasons. First, female employment is more likely to be endogenous to wages. The labor supply equation assumes constant parameters, but over the period, these parameters may have changed significantly and the effect of these changes on female labor supply may be much more than the effect on males. Secondly, due to the withdrawal of females from the labor market for parental duties, their experience level may not necessarily reflect the true level of experience being measured, which makes inference less meaningful.

Similar to Borjas et al. (2010), I consider the fact that people generally self-select into the labor force based on wages and so $\frac{H_{ist}}{H_{jst}}$ could be endogenous. I use the population sizes of these immigrants and natives as instrumental variables for labor supply, since it is plausible to assume the population size is not dependent on relative wages. To some extent, this should help us get past the first issue raised by Manacorda et al. (2012). Estimates from the instrumental variable regressions, shown in Table 2.2, illustrate results similar to the least squares regression results.

The estimated elasticities of substitution imply immigrants are closer substitutes to women than men in the labor market.[11] Therefore, immigrants are likely to have a stronger effect on the wages of native women, which to some extent, corroborates the observed higher impact on wages of native women compared to native men.

[11] based on the preferred specification.

2.6 Possible Factors Accounting for Differences in Wage Effects

As stated earlier, the apparent similarity between native women and immigrants, which may have led to a higher wage impact for women, could be explained in two principal ways. Since this framework controls for levels of observable skills, the differential wage impacts may signal some unobserved skill differences between native men and women which make native women closer technical substitutes for immigrants than native men. For example, unobserved skill differences could be differences in the types of occupations selected by men and women. On the other hand, the result could be explained by a simple assertion that there is labor market discrimination against immigrants and native women as a group. One would expect similar effects across education levels or experience levels if women faced categorical discrimination, but different effects if the results were due to unobserved skill differences between native men and women. In this section, I examine if the data is consistent with one theory or the other. Breaking down the immigration impact by education level, experience level or different periods in the data might reveal whether the data is more or less consistent with one competing explanation for the wage results.

2.6.1 Gender Specific Occupational Factors

A higher impact of immigration on the wages of native women, coupled with a marginally higher elasticity of substitution between women and immigrants, could suggest immigrants take up similar jobs as native women. Similarities in occupation may account for some factors unexplained by the skill groups framework being implemented. If there is some gender segregation in occupations in the labor market, then it may be reasonable to attribute these results partly to the fact that immigrants select into female dominant jobs. Blau et al. (2013) give occupational segregation an index of 64.5% in 1970, but the index drops to 51.0% in 2009, which gives a strong indication of gender dominance in a lot of occupations. To verify if immigrants disproportion-

ately select into female-dominant jobs, I initially estimate the average correlation between each native gender group and immigrants based on the number of people in each industry. I do this by using the industry classifications from the census data to put all workers into 28 industry categories. Immigrants have an industry correlation of 0.90 with males and 0.88 with females, which indicates immigrants do not necessarily select into female dominated occupations but are equally likely to take up male or female-dominated jobs.[12]

I look to further verify the importance of gender in the labor market choices of immigrants by viewing it from a different perspective. If gender is a major factor in job selection in this context, female immigrants should be closer substitutes for female natives, at least according to our theoretical framework. Table 2.3 has estimates of $-1/\sigma$[13] for native women and immigrants divided into gender groups. For each specification, there is a greater elasticity of substitution between native females and male immigrants. There is an even greater difference in the estimates shown by the preferred specification (Column 4), where the elasticity of substitution is about 250 (=1/0.004) for male immigrants, and just 10 (=1/0.098) for female immigrants. In a nutshell, native women appear to be more in competition with male immigrants than female immigrants in the labor market. This observation is in line with a number of studies (Cortes & Tessada, 2011, Farré et al., 2011 and Zallman et al., 2019) which find that a lot of female immigrants take up home production and care jobs, which allow a number of native women to contribute more labor.

Table 2.3: Estimates of $-1/\sigma$ - Native Women vs Immigrant Gender Groups

	1 No weights	2 Weighted	3 No Fixed Effects	4 All Fixed Effects
Male Immigrants	-0.063***	-0.060**	-0.052	-0.004
	(0.020)	(0.026)	(0.031)	(0.034)
Female Immigrants	-0.085***	-0.080***	-0.060	-0.098***
	(0.012)	(0.013)	(0.009)	(0.022)

[12]In their attempt to investigate the causes of the gender wage gap, Blau and Kahn (2017) observe that occupation and industry have become increasingly more important factors in explaining the gender wage gap.

[13]Also based on (2.7), with specifications identical to those in Table 2.2

2.6.2 Impact by Educational Attainment

Differences in educational attainment has been cited as a reason for the observed wage differential between men and women (see Blau & Kahn, 2017). Men have had higher educational attainment in the past, which may have given them greater human capital, but this trend has changed immensely. For instance, in 1962, women accounted for only 37% of people with at least a college degree, but in 2018, the figure rose to 51%.[14] Therefore, the gender impacts may be different because of significant differences in the gender distribution of educational attainment. Differences in the result across observable skill levels could suggest there may be unobservable skill differences between genders. For instance, there may be educational differences in the elasticity of wages with respect to experience. Such differences will be less consistent with a simple discrimination theory and favor an argument that there are important skill differences between men and women. If the result were driven by blanket discrimination, one would not expect the educational level to be a determinant of the impact of immigration; and so the effect should be similar across educational levels. I examine the extent to which educational level differences drive the result by dividing the data by college education status and re-estimating the impacts across the two groups.

Tables 2.4 and 2.5 show the results from the corresponding estimation - the preferred specification being Column 3.[15] The table shows that the impact of immigration on a native gender group depends on educational attainment. Native women with a college degree are affected differently from those without a college degree, and the same is true for native men.[16] This is inconsistent with a simple theory of discrimination, in which women face discrimination at levels of education. However, it does not preclude a more detailed discrimination story. For instance, women with college degrees may face more labor market discrimination than women

[14] https://www.statista.com/study/20939/higher-education-graduation-in-the-us-statista-dossier/

[15] The results of the estimation of the impact on the employment rates are presented here only to maintain consistency, but they do not contribute to the discussion.

[16] It is important to note that estimates which do not have statistical significance could be interpreted as being imprecise, rather than bearing evidence of a positive impact. The small sample size arising from the division of the data, easily leads to higher standard errors and sensitivity to specification.

without a college degree or vice versa.

Table 2.4: Impact of Immigration on Native Labor Market Outcomes - Low Education

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.11	-0.06	-0.02
	(0.12)	(0.16)	(0.08)
Women	-0.16	-0.16	-0.44***
	(0.20)	(0.27)	(0.12)
B. Dependent Variable: Employment Rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.13**	-0.16**	-0.23
	(0.05)	(0.06)	(0.14)
Women	-0.13**	-0.12	-0.31***
	(0.06)	(0.07)	(0.10)

2.6.3 Impact by Level of Work Experience

The extent to which the impact of immigration depends on gender differences in work experience could also indicate what factors to attribute the results to. For people in similar professional positions, women have been generally considered to have less work experience based on the perception that they have more work interruptions due maternity and home production. For instance, according to Polachek (1981), more labor force interruptions lead to depreciation of women's human capital, which depresses their wages. One of the previously cited explanations for the observed wage impacts could be more plausible than the other based on the dependence of the impacts on experience level. Similar to the previous analysis, blanket discrimination against women would likely be evidenced by similar effects across experience groups. On the other hand, markedly different effects across experience groups will be more consistent with an *unobserved skill differences* explanation such as variation in the education elasticity across experience groups.

Dividing the data into low and high experience categories and re-estimating the impacts

Table 2.5: Impact of Immigration on Native Labor Market Outcomes - High Education

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	0.95	2.42	1.89***
	(1.36)	(1.66)	(0.57)
Women	0.34	-0.12	0.18
	(1.52)	(0.94)	(2.19)
B. Dependent Variable: Employment Rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	0.75**	0.53*	-0.12
	(0.26)	(0.25)	(0.68)
Women	1.56***	1.90***	-2.20
	(0.44)	(0.38)	(1.42)

Each table has a sample with only 96 observations, since it each represents half the number of education groups. Standard errors are also clustered by skill groups.

provides a simple avenue to check if the result depends on level of experience. In Tables 2.4 and 2.5, I show results from the estimation of wage and employment rate impacts, where the data are divided into people with at least twenty years of work experience and people with less than twenty years of experience.[17] For both groups, the pattern shows a marginally higher effect on the wages of men in all specifications, except Column 3 - the most comprehensive specification, where the pattern is reversed. The point estimates however appear inconsistent, and this may be due to the estimation of several parameters with the small sample size arising from the division of the data. Nonetheless, we observe that the effect on the wages of women are not completely different across levels of work experience. The conclusion here is that we can not rule out a simple discrimination story, but the framework seems to adequately control for differences in years of experience and so it is unlikely the result is driven by differences in experience levels.

[17] since data is limited to people with at most 40 years of work experience

Table 2.6: Impact of Immigration - People with at least 20 years of Work Experience

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.52***	-0.44***	-0.48
	(0.10)	(0.08)	(0.29)
Women	-0.41***	-0.31***	-0.53
	(0.10)	(0.09)	(0.39)
B. Dependent Variable: Employment Rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.15***	-0.16***	-0.29
	(0.02)	(0.02)	(0.18)
Women	-0.20***	-0.19***	-0.57***
	(0.04)	(0.04)	(0.24)

Each table has a sample with only 96 observations, since it each represents half the number of education groups. Standard errors are also clustered by skill groups.

Table 2.7: Impact of Immigration - People with less than 20 years of Experience

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.49**	-0.44**	0.10
	(0.19)	(0.20)	(0.11)
Women	-0.32	-0.24	-0.26
	(0.21)	(0.24)	(0.16)
B. Dependent Variable: Employment Rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.19***	-0.24***	0.38*
	(0.06)	(0.07)	(0.19)
Women	-0.39***	-0.37***	0.05
	(0.09)	(0.10)	(0.06)

Each table has a sample with only 96 observations, since it each represents half the number of education groups. Standard errors are also clustered by skill groups.

2.6.4 Impact by Period

The major cause of differences in wages across genders remains unexplained throughout studies on the gender wage gap. The unexplained portion is usually attributed to labor market discrimination. As more reasons are provided for the gender wage gap, the unexplained portion has reduced over time, and so has the supposed effect of discrimination. Blau and Kahn (2017) for instance assign 48.5% of the gender wage gap in 1980 to unexplained factors, but this figure declines to 38.0% in 2010. Therefore, if discrimination accounts for differences in wage impacts of immigrants across genders, we should expect the impact on women to be much higher in the earlier part of the data.

To verify this, I divide the data into two periods - an earlier period from 1960 to 1980 and latter period from 1990 to 2010, and re-estimate the effects across these periods. The estimates for the early part of the data are mostly imprecise due to the large standard errors. Estimates for the latter part of the data show a strong negative impact of immigration on the wages of native women. The imprecision in the estimates for the early part of the estimates may be explained by the fact that there is less variability in that part of the data due to a much smaller number of employed people (especially women) in the sample. Nonetheless, the estimates strongly indicate the impacts are not greater in the early period, a finding which is inconsistent with a blanket discrimination interpretation. To the extent that discrimination still accounts for some of the differences, such discrimination may take a more complicated form, which is hard to measure.

2.7 Conclusion

In the analysis of impact of immigration on the labor market, not much attention has been paid to the difference in the impact across genders. Studies such as Cortes and Tessada (2011) and Zallman et al. (2019) have examined the effect of immigrant labor on females, but only considered low skilled female immigrants. Others, including Manacorda et al. (2012) and Ottaviano and Peri (2012) which assess national level impacts only include females as sub-samples to verify

Table 2.8: Impact of Immigration on Native Labor Market Outcomes - Early

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No interactions	Full Model
Men	0.00	0.21	-0.59
	(0.23)	(0.28)	(0.42)
Women	0.71***	0.78**	0.15
	(0.24)	(0.30)	(0.36)
B. Dependent Variable: Employment rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.08	-0.27	-0.43
	(0.15)	(0.16)	(0.37)
Women	0.53**	0.07	-0.30
	(0.22)	(0.24)	(0.53)

Each table has a sample with only 96 observations, since it each represents half the number of education groups. Standard errors are also clustered by skill groups.

Table 2.9: Impact of Immigration on Native Labor Market Outcomes - Late

A. Dependent Variable: Log of weekly wage			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.23**	-0.23**	-0.04
	(0.10)	(0.11)	(0.12)
Women	-0.52***	-0.52***	-0.55*
	(0.12)	(0.17)	(0.30)
B. Dependent Variable: Employment Rate			
	1	2	3
	Unweighted	No Interactions	Full Model
Men	-0.13**	-0.16**	-0.23
	(0.05)	(0.06)	(0.14)
Women	-0.13**	-0.12	-0.31***
	(0.06)	(0.07)	(0.10)

Each table has a sample with only 96 observations, since it each represents half the number of education groups. Standard errors are also clustered by skill groups.

the robustness of elasticity of substitution estimates. This study contributes by implementing the national level skill groups framework to estimate and compare the impact of immigration on the labor market outcomes across gender groups.

Essentially, I find that a 10% increase in the immigrant share of the labor supply is associated with a statistically insignificant decrease in the wages of native men, but about a 3.5% decrease in the wages of native women. Immigration however, has an almost identical impact on the employment rate of both native men and women. Across different specifications, native female wages are still impacted more than native male wages and there is a similar impact on the employment rates of both males and females. The results are identical when immigrant population share is used as an instrument for immigrant share of labor supply.

Following this, I look into the possible reasons that could account for the differences in the wage impacts. Since human capital is controlled for in this framework, the differential impacts could be mainly due to occupational differences, unobserved human capital differences or discrimination. I first check if immigrants impact female wages more because they select female-dominated jobs and compete more with females. I find that immigrants do not necessarily select into gender specific industries, and so occupational factors do not significantly influence the observed results. Having discounted occupational factors as a sources of the observed differences, unobserved skill differences and discrimination become the competing theories in explaining the results. If the result is due to simple discrimination against immigrants and native females, the impact of immigration should be similar across education and experience levels. Otherwise, unobserved skill differences could account for a major part of the results. I find that the effect is different across educational levels but similar across experience levels. Evidence from the educational level estimation favors an *unobserved skill differences* explanation, whilst evidence from the experience level comparison does not rule out a discrimination story. Lastly, as an additional way of assessing the effect of discrimination, I estimate the same effects across different time periods in the data. One would expect a significantly higher impact for females in the earlier portion of the data if the result were driven by discrimination, but the evidence shows

otherwise. Overall, the results seem to be driven more by unobserved skill differences between men and women, but still shows discrimination could be a major explanatory factor. The extent to which discrimination drives the result is however difficult to measure with this framework or any other framework used so far.

A vital part of implementing this framework is the set of assumptions accompanying it. This is sometimes the main source of differences in the literature. For instance, Borjas et al. (2010) sees the inclusion of time and skill group interaction effects as essential to estimation, whilst Ottaviano and Peri (2012) assert that it is plausible to exclude the interaction effects. I include both specifications and the pattern of the results remain the same, irrespective of the set of assumptions used. However, the issue of small sample size remains with this framework. In this study, for example, the skill groups and number of census years result in 192 observations, which leads to concerns with the number of degrees of freedom, especially when including interaction effects or dividing the data to analyse sub-groups. However, an advantage of this method is that it corrects the spatial arbitrage problem and uses immigrant population to address endogeneity. Nonetheless, there may exist a better instrumental variable to mitigate the effect of confounding factors.

This study represents a venture into a somewhat under-studied aspect of immigration labor dynamics, which is the national level impact of immigration on female labor market outcomes. Even after exploring a variety of reasons for gender differences in labor market, majority of studies attribute the largest cause of these differences to unexplained factors. The analysis has provided evidence that immigration impacts the wages of native men and women differently. I have investigated unobserved skill differences and discrimination as possible explanations for this observation, and a case could be made for both.

LIST OF REFERENCES

References

Altonji, J. G., & Card, D. (1991). The effects of immigration on the labor market outcomes of less-skilled natives. In *Immigration, trade, and the labor market* (pp. 201–234). University of Chicago Press.

Angrist, J., & Krueger, A. (1999). *Chapter 23-empirical strategies in labor economics. volume 3, part a of handbook of labor economics.* Elsevier.

Blau, F. D., Brummund, P., & Liu, A. Y.-H. (2013). Trends in occupational segregation by gender 1970–2009: Adjusting for the impact of changes in the occupational coding system. *Demography*, *50*(2), 471–492.

Blau, F. D., & Kahn, L. M. (2017). The gender wage gap: Extent, trends, and explanations. *Journal of Economic Literature*, *55*(3), 789–865.

Blundell, R., & MaCurdy, T. (1999). Labor supply: A review of alternative approaches. In *Handbook of labor economics* (Vol. 3, pp. 1559–1695). Elsevier.

Bordo, M. D., & MacDonald, R. (1997). *Violations of the rules of the game and the credibility of the classical gold standard, 1880-1914* (Tech. Rep.). National Bureau of Economic Research.

Bordo, M. D., et al. (1981). The classical gold standard: Some lessons for today. *Federal Reserve Bank of St. Louis Review*, *63*(5), 2–17.

Borjas, G. J. (2003). The labor demand curve is downward sloping: Reexamining the impact of immigration on the labor market. *The quarterly journal of economics*, *118*(4), 1335–1374.

Borjas, G. J., Grogger, J., & Hanson, G. H. (2008). *Imperfect substitution between immigrants and natives: A reappraisal* (Tech. Rep.). NBER Working Papers 13887.

Borjas, G. J., Grogger, J., & Hanson, G. H. (2010). Immigration and the economic status of african-american men. *Economica*, *77*(306), 255–282.

Cairnes, J. E. (1965). *Essays in political economy*. Augustus M. Kelley.

Card, D. (1990). The impact of the mariel boatlift on the miami labor market. *ILR Review*, *43*(2), 245–257.

Card, D. (2001). Immigrant inflows, native outflows, and the local labor market impacts of higher immigration. *Journal of Labor Economics*, *19*(1), 22–64.

Card, D., & Lemieux, T. (2001). Can falling supply explain the rising return to college for younger men? a cohort-based analysis. *The Quarterly Journal of Economics*, *116*(2), 705–746.

Carrington, W. J., & De Lima, P. J. (1996). The impact of 1970s repatriates from africa on the portuguese labor market. *ILR Review*, *49*(2), 330–347.

Cortes, P. (2008). The effect of low-skilled immigration on us prices: evidence from cpi data. *Journal of political Economy*, *116*(3), 381–422.

Cortes, P., & Tessada, J. (2011). Low-skilled immigration and the labor supply of highly skilled women. *American Economic Journal: Applied Economics*, *3*(3), 88–123.

Craig, L. A., Fisher, D., & Spencer, T. A. (1995). Inflation and money growth under the international gold standard, 1850–1913. *Journal of Macroeconomics*, *17*(2), 207–226.

Cumby, R. E., & Modest, D. M. (1987). Testing for market timing ability: a framework for forecast evaluation. *Journal of Financial Economics*, *19*(1), 169–189.

Devereux, P. J. (2004). Changes in relative wages and family labor supply. *Journal of Human Resources*, *39*(3), 698–722.

Easaw, J. Z., & Heravi, S. M. (2004). Evaluating consumer sentiments as predictors of uk household consumption behavior: Are they accurate and useful? *International Journal of Forecasting*, *20*(4), 671–681.

Edvinsson, R., Jacobson, T., & Waldenstrom, D. (2014). Historical monetary and financial statistics for sweden, volume ii: House prices, stock returns, national accounts, and the

riksbank balance sheet, 1620-2012. *Ekerlids Forlag. Sveriges Riksbank*.

Farré, L., González, L., & Ortega, F. (2011). Immigration, family responsibilities and the labor supply of skilled native women. *The BE Journal of Economic Analysis & Policy*, *11*(1).

Feinstein, C. H. (1972). *National income, expenditure and output of the united kingdom, 1855-1965* (Vol. 6). Cambridge University Press Cambridge.

Fratianni, M., & Spinelli, F. (1984). Italy in the gold standard period, 1861-1914. In *A retrospective on the classical gold standard, 1821-1931* (pp. 405–454). University of Chicago Press.

Friedman, M., & Schwartz, A. (1963). *A monetary history of the united states*. Princeton University Press.

Friedman, M., & Schwartz, A. J. (1982). *Monetary trends in the united states and the united kingdom: Their relations to income, prices, and interest rates*. University of Chicago Press.

Friedman, M., & Schwartz, A. J. (1983). *Monetary trends in the united states and the united kingdom: Their relations to income, prices, and interest rates*. University of Chicago Press.

Glasner, D. (1985). A reinterpretation of classical monetary theory. *Southern Economic Journal*, 46–67.

Glasner, D. (1989). *Free banking and monetary reform*. Cambridge University Press. Retrieved from `https://books.google.com/books?id=JUgynjw4d_4C`

Grossman, J. B. (1982). The substitutability of natives and immigrants in production. *The review of economics and statistics*, 596–603.

Henriksson, R. D., & Merton, R. C. (1981). On market timing and investment performance. ii. statistical procedures for evaluating forecasting skills. *Journal of business*, 513–533.

Hume, D. (1752). *Writings on economics*. Routledge.

Humphrey, T. M. (1981). Adam smith and the monetary approach to the balance of payments. *Federal Reserve Bank of Richmond Review*.

Johnson, H. G., & Frenkel, J. A. (1976). *The monetary approach to the balance of payments*. George Allen & Unwin.

Jones, M. T., & Obstfeld, M. (1997). *Saving, investment, and gold: A reassessment of historical*

current account data (Tech. Rep.). National Bureau of Economic Research.

Jonung, L. (1984). Swedish experience under the classical gold standard, 1873-1914. In *A retrospective on the classical gold standard, 1821-1931* (pp. 361–404). University of Chicago Press.

Jörberg, L. (1970). *The industrial revolution in scandinavia 1850-1914*. Collins Clear-Type Press.

Killingsworth, M. R. (1983). *Labor supply*. Cambridge university press Cambridge.

Klovland, J. T. (1983). The demand for money in secular perspective: The case of norway, 1867–1980. *European Economic Review*, *22*(2), 193–218.

Krantz, O., & Schön, L. (2007). *Swedish historical national accounts 1800-2000*. Almqvist & Wiksell International Lund and Stockholm.

Laidler, D. (1981). Adam smith as a monetary economist. *Canadian Journal of Economics*, 185–200.

Lévy-Leboyer, M., & Bourguignon, F. (1990). *The french economy in the nineteenth century: an essay in econometric analysis*. Cambridge University Press.

Manacorda, M., Manning, A., & Wadsworth, J. (2012). The impact of immigration on the structure of wages: theory and evidence from britain. *Journal of the European economic association*, *10*(1), 120–151.

McCloskey, D. N., & Zecher, J. R. (1976). How the gold standard worked, 1880-1913. *The Monetary Approach to the Balance of Payments*.

Mill, J. S. (1884). *Principles of political economy*. D. Appleton.

Mitchell, B. R. (1980). *European historical statistics, 1750-1970*. Springer.

Ottaviano, G. I., & Peri, G. (2012). Rethinking the effect of immigration on wages. *Journal of the European economic association*, *10*(1), 152–197.

Peri, G., & Sparber, C. (2009). Task specialization, immigration, and wages. *American Economic Journal: Applied Economics*, *1*(3), 135–69.

Pesaran, M. H., & Timmermann, A. G. (1994). A generalization of the non-parametric henriksson-merton test of market timing. *Economics Letters*, *44*(1-2), 1–7.

Polachek, S. W. (1981). Occupational self-selection: A human capital approach to sex differences in occupational structure. *The review of Economics and Statistics*, 60–69.

Rahlf, T. (2015). Germany in data. time series on historical statistics. Retrieved from `http://www.deutschland-in-daten.de/en/money-and-credit`

Ricardo, D. (1811). *The high price of bullion, a proof of the depreciation of bank notes.* John Murray.

Rich, G. (1984). Canada without a central bank: Operation of the price-specie-flow mechanism, 1872-1913. In *A retrospective on the classical gold standard, 1821-1931* (pp. 547–586). University of Chicago Press.

Saint Marc, M. (1983). *Histoire monetaire de la france: 1800-1980.* Presses Universitaires de France-PUF.

Samuelson, P. A. (1948). International trade and the equalisation of factor prices. *The Economic Journal*, *58*(230), 163–184.

Selgin, G. A. (1988). *The theory of free banking: Money supply under competitive note issue.* Rowman & Littlefield pub Inc.

Smith, A. (1776). The wealth of nations [1776].

Sprenger, B. (1982). *monetary changes in germany in the age of industrialization (1835 to 1913)* (No. 36). Research Institute for Social and Economic History at the University of K "o ln.

Sumner, S. (2015). *The midas paradox: Financial markets, government policy shocks, and the great depression.* Independent Institute. Retrieved from `https://books.google.com/books?id=kh5sngEACAAJ`

Thompson, E. A. (1974). The theory of money and income consistent with orthodox value theory. In *Trade, stability, and macroeconomics* (pp. 427–453). Elsevier.

Thompson, E. A. (1982). Free banking under a labor standard—the perfect monetary system. *unpublished manuscript, University of California, Los Angeles*, *14*, 224–39.

Thornton, H. (1802). *An enquiry into the nature and effects of the paper credit of great britain.* Routledge.

Viner, J., et al. (1924). Canada's balance of international indebtedness, 1900-1913.

Warren, G. F., & Pearson, F. A. (1935). *Gold and prices* (Vol. 6). Routledge.

Williamson, J. G. (1964). *American growth and the balance of payments, 1820-1913: a study of the long swing.* University of North Carolina Press.

Zallman, L., Finnegan, K. E., Himmelstein, D. U., Touw, S., & Woolhandler, S. (2019). Care for america's elderly and disabled people relies on immigrant labor. *Health Affairs*, *38*(6), 919–926.

VITA

Kwabena Boateng

University of Mississippi
Department of Economics
email: koboateng34@gmail.com

Education

University of Mississippi — Oxford, MS
PhD Economics — December, 2019

Committee Chair: Joshua R. Hendrickson

MA Economics — May, 2017

Kwame Nkrumah University of Science and Technology (KNUST) — Kumasi, Ghana
BSc. Statistics and Actuarial Science (Honors) — June, 2012

Research

Research Interests

Primary: Forecasting, Macroeconomics
Secondary: Labor and Immigration Economics

Working Papers

How did the Gold Standard Really Work? A Comparison of the Price Specie Flow Mechanism and the Monetary Approach to the Balance of Payments

Work in Progress

Interest on Reserves, Regime Switching and Monetary Policy Transmission

Effects of Immigration on Labor Market Outcomes for Females

Teaching Experience

Instructor

Business/Economic Statistics I — Fall 2017 - Fall 2018

Teaching Assistant

Principles of Microeconomics — 2014, 2018
Principles of Macroeconomics — Fall 2016
Discrete Mathematics — Spring 2013
Calculus III — Fall 2012

Conference Presentations

How did the Gold Standard Really Work?
45^{th} Annual Conference - Eastern Economic Association — March, 2019

Fellowships and Awards

Lewis Smith Scholarship 2018
(awarded by Department of Economics for outstanding academic achievement)
Graduate Dissertation Fellowship Fall, 2019

Professional Experience

Prime Insurance Limited
Analyst: Reinsurance and Statistics 2014

Stallion Consultants
Intern: Actuarial Valuation Summer, 2011

Professional Certifications

Society of Actuaries (SOA)
Exam P: Probability
Exam FM: Financial Mathematics
Exam MFE: Models for Financial Economics

Professional Affiliations

Society of Actuaries (SOA)
International Association of Black Actuaries (IABA)

Service

University of Mississippi
Research Analyst: Tennessee Valley Authority (TVA) Investment Challenge 2016 - 2017
Member: Graduate School Academic and Professional Development Committee 2016 - 2017
Graduate School Senate: Representative for Economics Department 2016 - 2017

Software Skills

R and Stata